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Risk Factors for Restricting Back Pain in Older Persons

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Abstract

Objectives—To identify risk factors for back pain leading to restricted activity (restricting back pain) in older persons.

Design—Prospective cohort study.

Setting—Greater New Haven, Connecticut.

Participants—731 men and women aged 70 years or older, who were community-living and non-disabled in essential activities of daily living at baseline.

Measurements—Candidate risk factors were ascertained every 18 months for 108 months during comprehensive home-based assessments. Restricting back pain was assessed during monthly telephone interviews for up to 126 months. Incident episodes of: (1) short-term (one episode lasting one month) restricting back pain; and (2) persistent (one episode lasting two or more months) or recurrent (two or more episodes of any duration) restricting back pain were determined during each 18-month interval. The associations between the candidate risk factors and short-term and persistent/recurrent restricting back pain, respectively, were evaluated using a multivariable Cox model.

Results—The cumulative incidence was 21.3% (95% confidence interval (CI) 19.6%, 23.1%) for short-term restricting back pain and 20.6% (CI 18.6%, 22.9%) for persistent/recurrent restricting back pain over a median follow-up of 109 months. In a recurrent event multivariable analysis, female sex (HR 1.30; 1.07, 1.58), weak grip strength (HR 1.24; 1.01, 1.52), and hip weakness (HR 1.19; 1.07, 1.32) were independently associated with an increased likelihood of having short-term restricting back pain, while female sex (HR 1.48; CI 1.13, 1.94), depressive symptoms (HR 1.57; 1.23, 2.00), 2 or more chronic conditions (HR 1.38; 1.08, 1.77), and arthritis (HR 1.66; 1.31, 2.09) were independently associated with persistent/recurrent restricting back pain.

Conclusion—In this prospective study, several factors were independently associated with restricting back pain, including some that may be modifiable and therefore potential targets for interventions to reduce this common and often recurrent condition in older persons.

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Keywords

Aged; Back Pain; Risk Factors; Cohort Studies

Introduction

Back pain is the most common type of pain reported by adults. Over 26% of adults report back pain lasting for at least one day in the past three months, and 2.3% of all office-based physician visits are related to this common condition (1). The total health care expenditures for back pain, in 2005 dollars, exceeded \$100 billion (2), and these costs are expected to rise as the prevalence of back pain increases (3). Factors that may contribute to long-term disability from back pain include age, prior back pain, below average self-reported health, strenuous work, unemployment, dissatisfaction with employment, and psychological distress (4, 5). Much of the literature on this condition comes from younger populations. Whether these findings are applicable to older populations is uncertain.

Despite the high prevalence, cost, and morbidity attributable to back pain, longitudinal data describing its epidemiology in older persons are sparse. In an earlier report, we demonstrated that back pain, severe enough to restrict activity (hereafter referred to as restricting back pain), in older persons is common, affecting about 80% of men and women over a decade, often short-lived, with median duration of only one month, and recurrent (6). Previous studies have shown that back pain in older persons is more common in women than men (1, 3, 6–10) persons who are overweight (7, 10, 11), and those who are depressed or have depressive symptoms (7–9, 12). Most of this literature, however, is cross-sectional and focuses exclusively on chronic (lasting three months) back pain. Few prospective studies have evaluated risk factors for restricting back pain, especially episodes that are short-lived or recurrent (13, 14).

The objective of this study was to identify independent risk factors for restricting back pain in older persons. We used data from a unique longitudinal study that includes monthly assessments of restricting back pain, and potential risk factors that were assessed every 18 months, for more than 10 years in a large cohort of older men and women who were community-living at baseline. Our goal was to identify factors that render older persons prone to developing restricting back pain, and ultimately, to recognize which older individuals may require more aggressive prevention or treatment strategies to prevent the occurrence, persistence, or recurrence of this common condition.

Methods

Study Population

Participants were members of the Precipitating Events Project (PEP), a prospective study of 754 non-disabled persons, aged 70 years or older who were initially residing in the community (15). Exclusion criteria included the need for personal assistance in one or more of four essential activities of daily living (ADLs): bathing, dressing, walking inside the house, and transferring from a chair; significant cognitive impairment with no available proxy; inability to speak English; diagnosis of a terminal illness with a life expectancy less than 12 months; and plans to move out of the New Haven area during the following 12 months. Participants who subsequently developed disability or moved into an institutional setting were retained in the cohort.

The assembly of the PEP cohort, which took place between March 1998 and October 1999, has been described in detail elsewhere (15). Potential participants included age-eligible

members of a large health plan in greater New Haven, Connecticut. Only 4.6% of the 2753 health plan members who were alive and could be contacted refused to complete the screening telephone interview; 75.2% agreed to participate in the study. Those who refused to participate did not differ significantly by sex or age from those who enrolled in the study (15). The Yale Human Investigation Committee approved the study protocol.

Data Collection

Data on candidate risk factors were collected during comprehensive home-based assessments completed at baseline and every 18 months for 108 months. Restricting back pain was assessed during monthly telephone interviews for up to 126 months. For participants with significant cognitive impairment or who were not available, these assessments were completed with the assistance of a designated proxy; this protocol has been shown to be reliable and valid as described in previous reports (16). Of the 754 participants in the original cohort, 452 (59.9%) died after a median follow-up of 74 months, and 35 (4.6%) dropped out of the study after a median follow-up of 25 months. Data were otherwise available for 99.6% of the 61,183 monthly interviews.

Candidate Factors

Potential risk factors for restricting back pain were evaluated from five domains: demographic, cognitive-psychosocial, health related, habitual, and physical capacity (Table 1). These factors have been linked to adverse functional outcomes in prior studies (17–19). Demographic factors included age, sex, race, living situation (living alone: yes/no), and education. Cognitive-psychosocial factors included cognitive status assessed by the Folstein Mini-Mental State Examination (MMSE) (20); depressive symptoms assessed by the Center for Epidemiologic Studies Depression (CES-D) scale (21); functional self-efficacy assessed by the modified Tinetti scale (22); and social support assessed by a modified version of the Medical Outcomes Study (MOS) Social Support Survey (23). Health related factors included self-report of 10 pound weight loss over the course of a year (24), and eight self-reported, physician-diagnosed chronic conditions, reported as the number of chronic conditions: hypertension, diabetes mellitus, myocardial infarction, chronic lung disease, cancer, stroke, congestive heart failure, and hip fracture. Self-reported physician diagnosed arthritis was evaluated separately (18). The habitual factors included physical activity, as assessed using the Physical Activity Scale for the Elderly (PASE) (25), and body mass index (BMI) was calculated using participants' self-reported height and weight.

The physical capacity factors included a modified version of the Short Physical Performance Battery (SPPB) (26) that included the standard balance maneuvers but substituted three timed chair stands (instead of five) and timed rapid gait (instead of timed usual gait), as previously described (19). Physical capacity factors included hand grip strength (27), and lower extremity (hip abduction) and upper extremity (shoulder abduction) strength (19). The amount of missing data for the candidate risk factors was less than 1% in the baseline assessment and less than 10% in all subsequent assessments. To account for missing data, multiple imputation was used with 50 random draws per missing observation. Additional operational details regarding the candidate risk factors are provided below.

The candidate risk factors were dichotomized, as described in prior reports, to facilitate clinical interpretation (19). Age was categorized as <85 and ≥85 years old and education was classified as completing <12 and ≥12 years of education. Participants were considered to be cognitively impaired if they scored <24 on the MMSE, and to have high depressive symptoms if they scored ≥16 on the CES-D. Low functional self-efficacy and low social support were defined based on cut points demarcating the worst quartile (score of ≤27 on the modified Tinetti scale (22), and ≤18 on MOS (23), respectively) on the basis of the first

356 enrolled participants who were selected randomly from the source population. Chronic conditions were classified as <2 and ≥ 2 conditions (based on frequency distributions in this sample). Low physical activity was defined as a PASE score of <64 for men and <52 for women (25). These sex-specific cut points denote the worst quintiles (27), also determined from a random sample from the source population (24). A BMI of ≥ 25 kg/m² was used to define overweight (World Health Organization definition). The SPPB, measured on a 0–12 scale, was dichotomized as <7 and ≥ 7 on the basis of previously defined cut points (28). Weak grip strength (dominant hand), assessed by averaging three readings using a Jamar Hydraulic handheld dynamometer (Sammon Preston Rolyan, Bolingbrook, IL) (24), was defined as values less than or equal to the sex- and BMI- specific cut-points provided by Fried et al (27). Hip weakness and shoulder weakness were assessed with a hand-held Chatillon MSE 100 dynamometer (AMATEK Measurement and Calibration, Largo, Florida). Cut points demarcate the worst sex-specific quartile for the nondominant limb, on the basis of the first 356 enrolled participants randomly selected from the source population (19).

Assessment of Restricting Back Pain

Back pain leading to restricted activity was assessed during monthly interviews. Each month, participants were asked, “Since we last talked, have you stayed in bed at least half the day due to an illness, injury, or other problem?” and, “Have you cut down on your usual activities due to an illness, injury, or other problem?” Participants who answered yes to either question were considered to have restricted activity and were subsequently asked whether their restricted activity was due to back pain. An episode of restricting back pain had to be preceded and followed by a month with no restricting back pain except in the case of death and at the end of the follow-up period. The reliability of the assessment for restricting back pain was high, with kappa = 0.84 (12).

Restricting Back Pain Subtypes

Based on prior research (6, 29), clinical judgment, and preliminary review of the data from the monthly telephone interviews, two mutually exclusive restricting back pain subtypes were evaluated: (1) short-term, defined as one episode lasting one month, and (2) persistent, defined as one episode lasting ≥ 2 months, or recurrent, defined as ≥ 2 episodes of any duration over an 18-month interval. Persistent/recurrent restricting back pain were grouped together because they reflect a greater burden compared with a short-term episode. Persistent restricting back pain represented 19.5% (396/2026) of all episodes in this subtype.

To take advantage of the updated risk factors assessed at each comprehensive assessment, the unit of analysis for this study was the 18-month interval. The first interval was excluded if participants reported restricted activity at baseline. Subsequent 18-month intervals were excluded if participants reported restricting back pain in the month prior to the start of an interval. Identifying incident episodes of restricting back pain was necessary to ensure temporal precedence when evaluating the association between potential risk factors and restricting back pain. Intervals for which there was no comprehensive assessment were excluded. Of the 3986 possible intervals, 424 (10.6%) were excluded for the following reasons: restricted activity was present at baseline ($n=204$); restricting back pain was present in the month prior to or during the comprehensive assessment ($n=159$), or the comprehensive assessment was not completed ($n=61$).

Statistical Analysis

The study sample included 731 (96.9%) of the 754 cohort participants; 23 participants were excluded because they contributed no intervals to the analysis. Specifically, 21 participants had restricted activity at baseline; of these participants, ten subsequently died, six dropped

out of the study, two had restricting back pain within a month of the second comprehensive assessment and died in the 2nd interval, and three refused subsequent comprehensive assessments. Two participants died after the baseline assessment but prior to the first monthly interview. The baseline characteristics were summarized using means and standard deviations for continuous variables, and frequencies and proportions for categorical variables.

The cumulative incidence of the two restricting back pain subtypes was estimated using a Generalized Estimation Equation binomial model. The 95% confidence intervals (CI) were based on empirical standard errors that accounted for the correlation of recurrent events in the same participants.

A multivariable Cox model for recurrent events was used to evaluate associations between the candidate risk factors and episodes of the two mutually exclusive restricting back pain subtypes. In this model, participants were at risk for developing both types of restricting back pain subtypes during the eligible 18-month intervals. All risk factors, other than sex and race, were updated every 18-months, and entered into the models as time-dependent variables. The crude and adjusted hazard ratios (HR) (and 95% CIs) for developing each restricting back pain subtype were estimated for each factor using the multivariable Cox model, with robust sandwich variance estimators to account for the correlation within individual (30, 31).

To create a parsimonious model, candidate risk factors were selected according to a hierarchical screening process (32). First, a bivariate Cox model was fit with each factor alone, resulting in an unadjusted HR. Factors were retained if they were associated with at least one restricting back pain subtype at $P < 0.20$ based on the likelihood ratio chi-square test (33). Next, nonparametric Spearman rank order correlations (34) were examined among the remaining factors. When the correlation coefficient was greater than 0.35, suggesting potential collinearity (19), a single factor was chosen from the correlated cluster based on clinical judgment and the strength of the bivariate association with the restricting back pain subtype. Lastly, the selected risk factors were simultaneously entered into the multivariable model, resulting in the adjusted HR and 95% CI.

All statistical tests were two-tailed, and $p < 0.05$ was considered to indicate statistical significance. All analyses were performed using SAS version 9.1 (SAS Institute, Inc., Cary, NC).

Results

Table 1 provides baseline characteristics of the study sample. On average, participants were nearly 80 years old, a majority were female, white, and had completed a high school education. A minority of participants were cognitively impaired or reported depressive symptoms. Fewer than half of the participants reported 2 chronic conditions, with the most common being hypertension (55%). Nearly 60% of the participants were overweight; a minority of these persons were obese (21%). The cumulative incidence (95% CI) of the two distinct subtypes of restricting back pain were 21.3% (19.6%, 23.1%) for short-term restricting back pain, and 20.6% (18.6%, 22.9%) for persistent/recurrent restricting back pain over a median follow-up of 109 months.

The bivariate associations of the candidate risk factors for short-term and persistent/recurrent restricting back pain, respectively, are also provided in Table 1. The strongest associations were observed for sex, high depressive symptoms, low functional self-efficacy, low social support, 2 chronic conditions, arthritis, low physical activity, overweight (for the persistent/recurrent subtype), and all of the physical capacity factors. All factors

associated with short term and/or persistent/recurrent restricting back pain ($P < 0.20$) were considered for entry into the multivariable model. Low functional self-efficacy, low physical activity, and shoulder weakness were highly correlated with SPPB (correlation coefficients .51, .41, .35, respectively) and were omitted from the multivariable analysis to reduce potential collinearity. Of these, low SPPB was chosen because of its stronger association with restricting back pain in the bivariate model (Table 1).

Table 2 provides the multivariable results for the factors associated with short-term and persistent/recurrent restricting back pain, respectively. In the final model, three factors (female sex, weak grip strength, and hip weakness) were independently associated with short-term restricting back pain, with HR ranging from 1.19 to 1.30. Four factors were independently associated with persistent/recurrent restricting back pain: female sex, high depressive symptoms, 2 chronic conditions, and arthritis, with HR ranging from 1.38 to 1.66.

Discussion

In this prospective cohort study of older persons, we evaluated potential risk factors for short-term and persistent/recurrent restricting back pain. The only risk factor that was independently associated with *both* short-term and persistent/recurrent restricting back pain was female sex. While poor grip strength and hip weakness were independently associated with short-term restricting back pain, having depressive symptoms, 2 chronic conditions, and self-reported arthritis were independently associated with persistent/recurrent restricting back pain. With the exception of female sex, the distinct risk factor profiles for the two subtypes of back pain provide evidence for the unique nature of acute, short-term versus persistent/recurrent restricting back pain. These findings may help to identify older persons at increased risk for developing different subtypes of restricting back pain and may facilitate recognition of susceptible older persons who warrant interventions or counseling to prevent the occurrence and/or recurrence of this condition.

Female sex was the one factor that was independently associated with both subtypes of restricting back pain. Multiple studies have shown that women are more likely than men to report back pain (35), although the underlying reasons for this difference are not fully known (36). Possibilities include sex differences (biological, psychological, sociocultural) in the perception, tolerance, expression and reporting of pain (35). Further research is needed to identify sex-specific precipitants of restricting back pain so that older men and/or women can be more aggressively targeted to prevent the occurrence and recurrence of restricting back pain.

The other risk factors that were independently associated with short-term restricting back pain were two measures of muscle weakness: grip and hip abduction (37). This is the first study, using prospective data, to show that muscle weakness is a risk factor specifically for the more acute, short-term subtype of restricting back pain in older persons. These results support the need for further studies to evaluate muscle strengthening interventions, focused particularly on lower extremity (hip) strengthening (38), for the prevention and/or treatment of short-term back pain in older persons.

One of the factors that *distinguished* short-term from persistent/recurrent restricting back pain was depressive symptoms. Depression and back pain (and pain in general) are strongly associated (12, 39); this relationship is complex and potentially reciprocal (40). In the current study, the temporal precedence between depressive symptoms and restricting back pain was established by ensuring that restricting back pain occurred *after* the assessment of depressive symptoms at each 18 month time interval. Clinically, it is reasonable to expect

that older persons with depressive symptoms may be at risk for the more burdensome subtype of restricting back pain. Older persons with depressive symptoms may exhibit poor pain coping strategies and may perceive back pain as more bothersome than their non-depressed counterparts (41), both of which may contribute to development of more refractory back pain symptoms. A randomized controlled effectiveness trial in older persons for the treatment of comorbid depression and chronic low back pain is underway (39).

Other independent risk factors for persistent/recurrent, but not short-term, restricting back pain included ≥ 2 chronic conditions (multimorbidity) and arthritis. Multimorbidity, where an individual has ≥ 2 chronic conditions, is common among older persons (42). A greater number of comorbid conditions and higher illness burden may lead to greater physical, emotional, psychological and social vulnerability that renders an older individual prone to suffering from restricting back pain. One study from Canada reported an increased risk of activity limitation, poorer self-rated overall and mental health, and higher health care use among individuals with concomitant back pain and arthritis compared with those having either condition alone (43). Future studies should evaluate the impact of multimorbidity and combinations of chronic conditions (including other sites of pain (44) and arthritis (18)) on outcomes in older persons with back pain. Since most older persons have multiple chronic conditions including osteoarthritis (45), it is essential to consider comorbid conditions when evaluating and treating back pain in older patients.

In both cross-sectional (46, 47) and longitudinal studies (11, 48), BMI (reflecting overweight and/or obesity) has been associated with chronic pain and specifically, low back pain. In our study, we found that being overweight was not independently associated with developing restricting back pain; we did not, however, have enough participants with a BMI >30 to examine whether obesity was associated with restricting back pain. Additionally, BMI was based on self-reported information that may not be as accurate relative to objective measurement.

This is the first study to report risk factors for different subtypes of restricting back pain using prospective data from a large sample of older persons over a long follow-up period. The literature has documented challenges to evaluating back pain that is recurrent (14, 49); this study utilizes monthly data on restricting back pain that allowed us to capture the recurrent nature of this condition. The subtypes evaluated in this study are clinically meaningful for two reasons: first, the back pain definition necessitates a threshold of severity requiring restricted activity; and second, the subtypes differentiate between short-term/acute versus longer-lasting/recurrent episodes of restricting back pain. While we are unable to distinguish between persistent and recurrent restricting back pain in this study (because of the relatively small proportion of episodes of persistent pain), our results provide novel information about these two subtypes. We were able to highlight distinct risk factors for each of the restricting back pain subtypes, which may aid in identifying older persons at higher risk for developing restricting back pain that is of short-duration versus persistent/recurrent. Another strength of this study is that the risk factors were updated every 18-months.

Several limitations of this study are worth mentioning. First, the severity, specific etiology, and the treatments used for restricting back pain were not assessed. Nonetheless, the definition of restricting back pain used in this study increased the likelihood that the reported symptoms were clinically meaningful. Second, it is possible that the risk factors, updated every 18 months, may have changed over shorter periods of time resulting in misclassification. Third, we evaluated a comprehensive, but not an exhaustive list of risk factors. Fourth, participants were initially community-living and nondisabled in essential activities of daily living. Nonetheless, because participants were retained in the cohort if

they developed disability or moved into an institutional setting, our results should be applicable to older persons across the continuum of function. Lastly, generalizability may be limited because participants were members of a single health care plan in the greater New Haven region. The demographics of our cohort mirror the US population except for race and ethnicity (50). Lastly, the associations reported in this observational study cannot be interpreted as causal despite our attempt to establish temporal precedence between the candidate risk factor and subsequent restricting back pain.

In summary, restricting back pain that is short-lived versus more persistent/recurrent are distinct entities and our study has identified several potentially modifiable risk factors, including depressive symptoms, multimorbidity, and arthritis, for the more burdensome subtype of restricting back pain. Given their heightened risk for persistent/recurrent restricting back pain, more aggressive treatment or preventive strategies should be considered for older persons with these conditions. Similarly, our finding of muscle weakness as a risk factor for acute short-term restricting back pain provides motivation for developing more effective (and sustainable) muscle strengthening programs. Our findings support the need for multi-factorial intervention trials that target these specific risk factors to reduce the occurrence, recurrence and/or persistence of restricting back pain in older persons.

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Baseline Characteristics and Bivariate Associations Between Potential Risk Factors and Short-Term and Persistent/ Recurrent Restricting Back Pain (N = 731)

Table 1

Characteristic ^a	Baseline Value ^b	Short-Term P-value	Persistent/ Recurrent P-value	Bivariate Results Hazard Ratio
Demographic				
Age ^c in years, mean (SD)	78.4 (5.2)			
70–74	206 (28.2)			
75–79	234 (32.0)			
80–84	196 (26.8)			
85 +	95 (13.0)	1.20	0.051	0.97
Female	475 (65.0)	1.31	0.008	1.72
Non-Hispanic white	661 (90.4)	1.18	0.312	0.90
Living alone	292 (40.0)	0.93	0.452	1.17
Did not complete high school	239 (32.7)	1.01	0.375	0.96
Cognitive-Psychosocial				
Cognitive impairment	85 (11.6)	1.20	0.120	1.04
High depressive symptoms	145 (19.8)	1.36	0.002	2.06
Low functional self-efficacy	225 (30.8)	0.99	0.001	0.97
Low social support	161 (22.0)	0.99	0.001	0.96
Health Related				
No. chronic conditions 2	313 (42.8)	1.11	0.006	1.22
Arthritis	241 (33.0)	1.22	0.038	1.97
Weight loss of 10 pounds in past year	149 (20.4)	1.22	0.061	1.35
Habitual				
Low physical activity	231 (31.6)	1.29	0.006	1.44
Overweight	435 (59.5)	1.02	0.756	1.27
Physical Capacity				
Low Score on Short Physical Performance Battery	344 (47.1)	1.34	0.003	1.64
				<0.001

Characteristic ^a	Baseline Value ^b	Bivariate Results Hazard Ratio		
		Short-Term	P-value	P-value
Weak grip strength	414 (56.6)	1.45	<0.001	<0.001
Hip (lower extremity) weakness	297 (40.6)	1.27	<0.001	<0.001
Shoulder (upper extremity) weakness	255 (34.9)	1.21	<0.001	<0.001

^aDescribed in detail in the methods section

^bValues are reported as numbers (percentages) unless otherwise indicated

^cAge is dichotomized as < or >=85 for bivariate analyses

Table 2

Factors Associated in Multivariable Analysis with Short-Term and Persistent/ Recurrent Restricting Back Pain (N = 731)

Factor	Hazard Ratio (95% Confidence Interval)			
	Short-Term	P-value	Persistent/ Recurrent	P-value
Demographic				
Aged 85	1.01 (0.82–1.25)	0.893	0.80 (0.61–1.04)	0.091
Female	1.30 (1.07–1.58)	0.009	1.48 (1.13–1.94)	0.005
Living alone	0.85 (0.70–1.03)	0.096	1.00 (0.79–1.27)	0.985
Did not complete high school	0.86 (0.70–1.06)	0.149	1.13 (0.86–1.49)	0.379
Cognitive-Psychosocial				
Cognitive impairment	1.08 (0.84–1.38)	0.571	0.82 (0.59–1.15)	0.245
High depressive symptoms	1.14 (0.92–1.40)	0.232	1.57 (1.23–2.00)	<0.001
Low social support	1.06 (0.85–1.31)	0.606	1.01 (0.76–1.34)	0.932
Health Related				
No. chronic conditions 2	1.19 (0.99–1.42)	0.065	1.38 (1.08–1.77)	0.012
Arthritis	1.08 (0.90–1.30)	0.408	1.66 (1.31–2.09)	<0.001
Weight loss 10 pounds in past year	1.08 (0.88–1.33)	0.461	1.13 (0.89–1.44)	0.313
Habitual				
Overweight	1.03 (0.86–1.24)	0.722	1.22 (0.96–1.56)	0.109
Physical Capacity				
Low Score on Short Physical Performance Battery	0.99 (0.79–1.24)	0.929	1.13 (0.86–1.48)	0.399
Weak grip strength	1.24 (1.01–1.52)	0.036	1.30 (1.00–1.71)	0.054
Hip (lower extremity) weakness	1.19 (1.07–1.32)	0.001	1.13 (1.00–1.29)	0.051