The moderating role of flexible goal adjustment in the link between pain and depressive symptoms: findings based on a nationally representative sample of older adults

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Abstract

Background: Pain is a frequent phenomenon in old age. It has been shown that increases in pain are longitudinally associated with depressive symptoms. This strong link can be attenuated by coping strategies like resilience. However, to date, there is a lack of longitudinal studies, based on nationally representative samples that have examined whether flexible goal adjustment moderates the relation between pain and depressive symptoms. Thus, the purpose of this study was to identify whether there is a longitudinal association between pain and depressive symptoms, and to examine whether flexible goal adjustment moderates this link.

Methods: Longitudinal data (wave 3 and wave 4; 5582 observations) were taken from a sample (German Ageing Survey) which is nationally representative for middle-aged and older adults (40 years and over). A widely used pain measurement (single-item measure) served as the key independent variable. An instrument created by Brandstaedter and Renner was used to quantify flexible goal adjustment. The 15-item version of the Centre for Epidemiologic Studies Depression Scale was used to measure depressive symptoms.

Results: Linear fixed effects regressions demonstrated that an increase in pain was associated with an increase in depressive symptoms ($\beta = 0.42$, $P < 0.001$). Moreover, flexible goal adjustment significantly moderated this association ($\beta = -0.39$, $P < 0.01$). With regard to potential confounders, an increase in depressive symptoms was associated with increasing age and worsening self-rated health.

Conclusion: The study findings showed that increasing pain leads to more depressive symptoms using a longitudinal approach. In addition, flexible goal adjustment moderated this link. Therefore, programs aiming at improving flexible goal adjustment may assist in avoiding an increase in depressive symptoms alongside pain increases among older adults.

INTRODUCTION

It is widely acknowledged that the demographic structure is changing in industrialised countries. This means that the number of individuals in old age is increasing. Because age is positively associated with pain,1 it is expected that the number of individuals suffering from pain, a highly prevalent phenomenon,2 will considerably increase. Pain is associated with adverse outcomes such as inability to work, decreased social relationships, and suicidal thoughts.3 Beyond that, increases in pain are associated with more depressive symptoms over time.4,5 This strong relation can be attenuated by coping strategies such as mastery or resilience.5,6 A factor mostly overlooked in previous studies is flexible goal adjustment (FGA; a factor that is also known as accommodative coping), the ability to adjust one’s own preferences to situational constraints,7 for example, when pain is perceived as unchangeable, we assume that FGA is important to avoid or at least reduce depressive symptoms.
Coffey demonstrated in a cross-sectional study that, particularly in patients with a high level of pain, FGA is associated with reduced negative affect. Furthermore, a second cross-sectional study showed that FGA moderated the link between pain intensity and depression among chronic pain patients. However, there is a lack of longitudinal studies, based on nationally representative samples that have examined whether FGA moderates the relation between pain and depressive symptoms.

As for potential mechanisms, it appears plausible to us that individuals could decrease the number of goals they have in life, or could find importance in pain. This could contribute to the process of reprioritising aspects of one’s life. Consequently, it may be difficult for these individuals to find meaning in other domains of life (e.g., family life). Thus, depressive symptoms might increase. In contrast, individuals who score high in FGA may quickly adapt to increases in pain and consequently can focus on other fulfilling life domains.

Knowledge about such a moderating role may contribute to strategies seeking to avoid an increase in depressive symptoms when pain increases in older adults. This is important because depressive symptoms in turn can lead to functional losses or mortality. It is also associated with a tremendous economic burden. Consequently, the aim of this study was to clarify the longitudinal association between pain and depressive symptoms, and to examine whether FGA moderates this link, using a nationally representative sample.

**METHODS**

**Sample**

For reasons of data availability, data were taken from wave 3 (year 2008) and wave 4 (year 2011) from the German Ageing Survey (Deutscher Alterssurvey; DEAS), covering topics such as social support, labour force participation, retirement or perception of ageing. This nationally representative sample of non-institutionalised individuals ≥40 years started in 1996 (first wave). Further waves took place in 2002 (wave 2), 2008, 2011 and 2014 (wave 5). The Federal Ministry for Family Affairs, Senior Citizens, Women and Youth funded the DEAS study.

The aim of this study is ‘to provide a representative national database containing information describing the living conditions of the country’s middle-aged and older population’ (p. 1105). Thus, the inclusion criterion was that individuals had to be 40 years or older. More precisely, participants who took part for the first time had to be born between 1929 and 1974 and residing in a private household. This also means that individuals living in institutionalised surroundings were excluded. Panel participants were included when they had at least one valid interview in previous waves, were willing to take part in the panel (i.e., written consent provided by baseline participants), were still alive and were not living abroad.

In wave 3, 8200 individuals took part (38% response rate), and 4855 individuals took part in wave 4 (56% response rate). The response rate from the DEAS study is comparable to other survey studies conducted in Germany.

The DEAS study has a cohort-sequential design. This means that baseline samples were introduced in the first, second, third and fifth waves, while a pure panel sample (i.e., only including individuals who had taken part before) was conducted in the fourth wave. Additional details regarding the DEAS study have been provided by Klaus et al.

Written informed consent was given by all individuals. An ethics statement for the DEAS study was not needed, as the criteria for it were not met (e.g., examination of patients, risk for the respondents, or the use of invasive methods).

**Dependent variable**

The well-established and widely used 15-item version of the Centre for Epidemiologic Studies Depression Scale (CES-D) was used to assess depressive symptomatology. It ranges from 0 (indicating no depressive symptoms) to 45 (indicating severe depressive symptoms). The CES-D has very good psychometric characteristics.

**Independent variables**

Our key independent variable was pain. It was assessed using a single-item measure. The exact wording was as follows: ‘Have you had constant or recurring pain in the last 4 weeks, and if so, how severe was it?’ (1 = I didn’t have any pain; 2 = very slight; 3 = slight; 4 = moderate; 5 = severe; 6 = very
severe). This single-item measure was created in line with previous research.\(^{22,23}\)

With regard to potential confounders, age, marital status (married, and living together with spouse); others (married, living separated from spouse; divorced; widowed; single), labour force participation (employed; retired; other: not employed), number of important people in regular contact (from 0 to 9), self-rated health (from 1 = very good to 5 = very bad), and the number of physical illnesses (e.g., cancer, sum score ranging from 0 to 11) was adjusted for in a regression analysis.

**Moderating factor**

A scale, originally developed by Brandtstädter and Renner,\(^7\) was used in the DEAS study to assess FGA. The questions asked (from 1 = strongly agree to 5 = strongly disagree) were for example: ‘I find it easy to see something positive even in a serious mishap’, ‘I find that even life’s troubles have a bright side’ as well as ‘I adapt quite easily to changes in plans or circumstances’. By building the average of the items, the FGA score is calculated. Higher values correspond to higher FGA. Cronbach’s alpha was 0.83 in our study.

**Statistical Analysis**

Similar to other studies analysing the longitudinal determinants of depressive symptoms,\(^{24,25}\) we used linear fixed effects (FE) regression models in order to analyse whether changes in pain are associated with changes in depressive symptoms. FE regression models rely on rather weak assumptions. They deliver consistent estimates, including when time-constant factors (e.g., genetic factors) are related to the explanatory variables (in contrast to other panel regression models). Our choice was also supported by Hausman tests with robust standard errors (e.g., model used in Table 2 first column: Sargan-Hansen statistic = 76.76, \(P < 0.001\)).

A popular synonym for the FE estimator is ‘within-estimator’ because it exclusively uses changes within participants over time. For example, changes in the pain reported by the same respondents in 2008 and 2011 were used in FE regressions. That is why factors not varying over time cannot be included as explanatory variables in FE models. Robust standard errors were calculated.\(^{26}\) The significance level was set at \(P < 0.05\). Stata 15.1 (StataCorp, College Station, TX, USA) was used in our study.

**RESULTS**

**Sample characteristics**

In Table 1, sample characteristics for individuals included in FE regressions are described. In total, 49.5% were female, 50.4% of the sample had a mid-level education and mean age was 63.7 years

| Table 2 Determinants of depressive symptoms. Results of linear fixed effects regressions (wave 3 to wave 4) |
|---------------------------------------------------------------|
| Independent variables | (1) Depressive symptoms: main model | (2) Depressive symptoms: main model with interaction term |
| Age | 0.11*** (0.04) | 0.12*** (0.04) |
| Family status: other (married, living separated from spouse; single; divorced; widowed) (Ref.: married, living together with spouse) | 0.78 (0.85) | 0.80 (0.85) |
| Employment status: retired (Ref.: employed) | −0.19 (0.50) | −0.15 (0.50) |
| Other: not employed | 0.82 (0.49) | 0.75 (0.48) |
| Number of important people in regular contact | −0.05 (0.03) | −0.06 (0.03) |
| Self-rated health (from 1 = very good to 5 = very bad) | 1.77*** (0.18) | 1.75*** (0.17) |
| Number of physical illnesses | 0.15 (0.08) | 0.15 (0.08) |
| Pain | 0.42*** (0.07) | 1.85*** (0.44) |
| Flexible goal adjustment | 0.32 (0.31) | |
| Interaction term: flexible goal adjustment scale × pain | −0.39** (0.12) | |
| Constant | −6.59** (2.34) | −8.42** (2.68) |
| Observations | 5684 | 5582 |
| Number of individuals | 2842 | 2791 |
| \(R^2\) | 0.090 | 0.101 |

Beta-coefficients were reported; cluster-robust standard errors in parentheses. * \(P < 0.05\), ** \(P < 0.01\), *** \(P < 0.001\).
(±10.9 years; ranging from 40 to 95 years). Mean FGA was 3.6 (±0.6), mean pain was 2.4 (±1.6) and mean depressive symptoms was 6.1 (±5.8). Further details are displayed in Table 1.

Regression analysis
Linear FE regressions are displayed in Table 2. Regressions demonstrated that an increase in pain was associated with an increase in depressive symptoms (β = 0.42, P < 0.001). Moreover, FGA significantly moderated this association (β = −0.39, P < 0.01). Figure 1 visualises the interaction (it was created using the ‘marginsplot’ command in Stata). Further regression analysis showed that FGA also moderated the link between pain and depressive symptoms in men (β = −0.33, P < 0.05) as well as in women (β = −0.44, P < 0.05; not displayed in Table 2).

With regard to potential confounders, an increase in depressive symptoms was associated with increasing age and worsening self-rated health. An increase in depressive symptoms was not significantly associated with changes in employment status, family status, or changes in the number of important people in regular contact or changes in the number of physical illnesses.

Table 1 Sample characteristics for individuals (N = 5582) included in linear fixed effects regressions (waves 3–4, pooled)

| Variables                              | n (%) / mean (SD) |
|----------------------------------------|-------------------|
| Female, n (%)                          | 2764 (49.5%)      |
| Education (ISCED-97), n (%)            |                   |
| Low education                         | 306 (6.6%)        |
| Medium education                      | 2351 (50.4%)      |
| High education                        | 2002 (43.0%)      |
| Age in years, mean (SD); range        | 63.7 (±10.9); 40 to 95 years |
| Married, living together with spouse, n (%) | 4158 (74.5%) |
| Employment status, n (%)              |                   |
| Employed                               | 1932 (34.6%)      |
| Retired                                | 3036 (54.4%)      |
| Other, not employed                    | 614 (11.0%)       |
| Number of important people in regular contact, mean (SD) | 4.9 (±2.7) |
| Morbidity, mean (SD)                  | 2.4 (±1.8)        |
| Self-rated health, from 1 = very good to 5 = very bad, mean (SD) | 2.4 (±0.8) |
| Flexible goal adjustment, scale, mean (SD) | 3.6 (±0.6) |
| Pain, from 1 = lowest to 6 = very severe, mean (SD) | 2.4 (±1.6) |
| Depressive symptoms, CES-D, mean (SD) | 6.1 (±5.8) |

Comments: The variables gender and education were not included in fixed effects regressions as independent variables since they are time-constant. These two variables are only depicted for descriptive purposes.

DISCUSSION
Main findings
Based on data from a nationally representative sample of individuals aged 40 and over, the objectives of this study were: (a) to identify the longitudinal association between pain and depressive symptoms; and (b) to examine whether FGA moderates this link. In our study, longitudinal regression models showed that an increase in pain was associated with an increase in depressive symptoms. Furthermore, in our study, FGA significantly moderated this association (in the total sample and in both genders). Thus, FGA can alleviate the negative impact increasing pain has on depressive symptoms.

Previous research and possible explanations
Cross-sectionally, there is evidence showing that pain is associated with depressive symptoms.13,14 This association is often explained by the fact that increased pain is associated with impaired functioning. This in turn is linked to more depressive symptoms.4,5,27 Our longitudinal study showed that increases in pain within individuals over time could increase depressive symptoms. However, the particular benefit of our study is that we additionally showed that FGA moderates the relation between pain and depressive symptoms over time, that is, FGA can alleviate the negative impact increasing pain has on depressive symptoms.

With regard to FGA, a few cross-sectional studies have examined the association between FGA and outcomes such as negative emotions or depressive symptoms.8,9,13,14,28 One of those cross-sectional studies, for instance, found that FGA was associated with reduced depression in Twente, Netherlands (n = 305).28 Based on rather small samples in other countries, similar findings were made, for example, by Boerner14 (n = 107; USA), Van Damme13 (n = 117; Belgium) and Schmitz9 (n = 118; Germany). In addition, Schmitz found that FGA significantly moderated the link between pain intensity and depression in a sample of chronic pain patients.9 Likewise, in another cross-sectional study, Coffey8 (n = 98; recruited from two urban hospitals in Ireland) showed that FGA
significantly moderated the association between pain intensity and negative affect, a concept closely related to depression. Thus, the beneficial effect of FGA was strongest at high levels of pain intensity.

We assume that the main study finding – the moderating role of FGA – may be explained by the fact that individuals who score high in FGA might find meaning in pain, or in accepting it. Furthermore, they might accordingly reshape their goals and priorities in life. For example, family life or social relationships may become more important. These factors may help to avoid depressive symptoms. However, future research is required to elucidate the underlying mechanisms.

Strengths and limitations
Some strengths of this study are worth noting. A few studies have already shown that an increase in pain can contribute to increases in depressive symptoms.4,5 We add to current knowledge by showing that FGA can longitudinally moderate the relation between pain and depressive symptoms. Panel data were used from the DEAS study, a well-known nationally representative sample of individuals ≥40 years residing in Germany. The problem of unobserved heterogeneity, a main challenge in large survey studies, was reduced using FE regression analysis. Depressive symptoms and FGA were both measured using instruments which show favourable psychometric properties. With regard to limitations, it should be stressed that a single-item measure was used to assess pain. It showed good reliability and validity. However, more elaborated measures should be used in future research. It has been demonstrated that sample selection bias in the DEAS study is rather small.18 In our study, changes in pain were used as explanatory variables and changes in depressive symptoms served as dependent variables. However, evidence exists showing that depressive symptoms can lead to increased pain (reverse causality).27 Clarifying the directionality of this relationship requires, for example, the use of instrumental variable approaches (IV). The IV-approach depends heavily on the validity of the instruments used (‘weak instruments problem’). If weak instruments are present, estimates are seriously biased. Consequently, linear FE regressions were used in the current study.

CONCLUSION
The study findings showed that increasing pain leads to more depressive symptoms. In addition, it was shown that FGA moderated this link. Therefore, programs aiming at improving FGA may assist in avoiding an increase in depressive symptoms alongside pain increases among older adults.

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