



The Role of Health Locus of Control in Pain Intensity Outcome of Conservatively and Operatively Treated Hand Surgery Patients

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Abstract

Purpose Psychological factors have shown to be associated with treatment outcomes in hand injury patients. This study aimed to investigate the role of health locus of control (HLOC) and its dimensions internal, social-external, and fatalistic-external HLOC in treatment outcomes of hand injury patients.

Method One hundred thirty-two consecutive patients of a tertiary center for hand surgery undergoing treatment for acute hand injury or degenerative hand problems were included in this study. Pretreatment levels of depression, anxiety, HLOC, and pain intensity were measured, along with pain intensity levels at 4-month follow-up. Hierarchical regression analyses were calculated to test for moderation effects of the HLOC dimensions on the relationship between pretreatment and follow-up pain intensity.

Results Controlling for age, gender, treatment modality, source of hand pain, and depressive symptoms, a moderation effect emerged ($\beta = -0.16$, $p < 0.05$), such that among patients higher in initial pain intensity, those lower in social-external HLOC experienced higher pain intensity at follow-up compared to those with high social-external HLOC. Internal HLOC and fatalistic-external HLOC did not moderate the effect of initial pain intensity on pain intensity at follow-up.

Conclusion Hand injury patients suffering greater initial pain intensity who also had lower versus higher social-external HLOC experienced less favorable treatment outcome. This finding suggests that if patients with high initial pain succeed in transferring perceived health control to professionals and to gain confidence in treatment and clinicians, treatment outcome could be improved in hand surgery.

Keywords Hand injury · Health locus of control · Chronic pain · Depression · Hand surgery

Introduction

Hand injuries are highly prevalent and burdening [1, 2], and degenerative hand problems represent a common joint disorder [3]. While most patients benefit from surgical and

conservative treatment, some patients' pain persists despite and beyond therapeutic interventions [4]. Patients with chronic hand pain (i.e., ≥ 3 months) [5] are often treated in hand surgery facilities [6]. In hand surgery patients, psychological factors have emerged as important aspects to consider in treatment planning [7, 8] and psychopathological symptoms such as depression have shown to predict treatment outcome [4, 9]. Moreover, a biopsychosocial perspective highlights the importance of considering biological, psychological, and social aspects in hand surgery [7, 10]. Psychological factors regarding perception and appraisal of illness and treatment aspects in social settings such as patient-clinician relationships appear crucial regarding outcome [7].

Health locus of control (HLOC), i.e., beliefs about factors controlling personal health [11], has been shown to predict outcomes in various health domains, such as back pain [12], Parkinson's disease [13], elderly patients' health [14], and chronic illnesses such as cardiovascular disease and diabetes [15, 16]. While internal HLOC (I-HLOC), i.e., beliefs of

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personal control over health, seems beneficial [12, 14, 15, 17–19], external HLOC has generally been related to poorer health [20, 21]. Self-efficacy, a construct related to I-HLOC [22], has been demonstrated to predict positive outcomes in hand surgery [4, 10]. One subtype of external HLOC, fatalistic-external (FE-HLOC), representing beliefs that fate or luck controls one's health, has been shown to have associations with negative health behaviors [17], poorer self-rated health [15], depression [23], and worse outcomes in chronic pain patients [18].

The second subtype of external HLOC, social-external (SE-HLOC, also termed “powerful-others” HLOC), representing beliefs that others (i.e., health professionals) control health, has shown associations with poorer self-rated health [15], worse back pain treatment outcomes [16], and less use of cognitive self-management techniques in persistent pain patients [24]. However, SE-HLOC has also shown associations with stronger adherence to medical recommendations [25]. Generally, the associations between SE-HLOC and health behaviors have been inconsistent [17]. Patients' abilities to transfer control to surgeons during treatment have been discussed as an important facet of trust in surgeon-patient relationships and potentially predictive of favorable treatment outcome [26]. Patients' trust in physicians is generally viewed as important in therapeutic relationships and predictive of positive health outcomes [27]. SE-HLOC has demonstrated positive correlations with patient trust in physicians [28, 29] and healthcare systems [30], suggesting its benefit in particular treatment settings.

HLOC emerged as a key predictor of recovery from traumatic occupational hand injury following surgery [10], and its relevance in predicting post-operative pain has been demonstrated [31]. However, studies investigating predictive, but also moderating roles of HLOC and its specific dimensions for pain intensity outcome in patients undergoing surgical or conservative treatment for hand-specific problems are sparse. Importantly, HLOC dimensions represent conceptually separate, and statistically independent constructs, as internal and external HLOC do not reflect opposite constructs [32]. Someone may simultaneously experience high internal and external HLOC (i.e., a patient believing in both personal and clinicians' control over health). According to the original theoretical framework, HLOC dimensions are conceptualized as potential predictors of health behaviors, as well as moderators of health-promoting behavior [25].

The present study aims to investigate the role of HLOC in predicting pain intensity outcome in patients treated in a hand surgery center. We hypothesized positive associations between I-HLOC and pain outcome, and negative associations between FE-HLOC and pain outcome. Since literature on SE-HLOC shows inconsistent associations with health aspects, we hypothesized SE-HLOC would moderate effects of initial pain intensity on pain intensity at follow-up. Our prior study

based on these data demonstrated a link between psychological symptoms and pain outcomes [9]. To our knowledge, this is the first study investigating the role of HLOC for treatment outcome in hand surgery patients.

Methods

Study Design and Patient Population

One hundred thirty-two consecutive patients admitted to a tertiary hand surgery center were included over 6 months in this prospective study. Patients were at least 18 years old and no selection criteria were implemented regarding pain levels at entry or comorbid diagnoses. The local ethics committee approved the study protocol (KEK-Nr.117/12) and patients provided informed consent. Initial and 4-month follow-up interviews were conducted by the same investigator at the medical consultation with hand surgeons blinded to psychometric data. In total, 125 patients completed follow-up assessment. Seven patients lost to follow-up did not significantly differ from all other patients in the variables studied, implying random dropout occurrence.

Instruments

At entry, a pain-symptom history was documented and patients completed self-rated psychometric questionnaires. The German Health and Illness Related Control Beliefs Questionnaire (KKG) assessed health- and illness-related locus of control [33], which is based on the Multidimensional Health Locus of Control Scale (MHLOC; [11]). The KKG assesses the three dimensions *internal*, *social-external* (powerful-others-external), and *fatalistic-external* (chance-external) locus of control with 21 items. All scales yielded acceptable to good internal consistencies (Cronbach's alphas: 0.81 for the internal scale; 0.65 for the social-external scale; 0.80 for the fatalistic-external scale). The depression subscale of the German Hospital Anxiety and Depression Scale (HADS; [34]) was used to measure depression, and yielded acceptable internal consistency (Cronbach's alpha: 0.77). Pain intensity was measured at entry and follow-up using a visual analog scale (VAS) ranging from 0 (no pain) to 10 (worst imaginable pain) [35]. Pain intensity cutoff scores to determine clinically relevant severity have been proposed (VAS ≥ 3 , [36]).

Data Analysis

Analyses were conducted with IBM SPSS 24 with $p < 0.05$ (two-tailed) as the statistical significance threshold. First, paired t tests were conducted to examine change in pain intensity from entry to follow-up. Second, Pearson's r and

Spearman's rho correlation coefficients were computed for normally and non-normally distributed data, respectively. Lastly, hierarchical linear regression analyses were conducted for each HLOC dimension in separate analyses testing direct effects of HLOC subscales and interaction effects between HLOC dimensions and initial pain levels with *z*-standardized terms in predicting pain outcome at follow-up, while controlling for age, gender, reason for admission (degenerative hand problems or hand injuries), treatment procedure (a more detailed description is published in [9] in Table 2), HADS depression scores, and initial pain intensity. For variables with below 5% missing data (missing completely at random; Little's MCAR test n.s.), the expectation-maximization algorithm was applied. Data were excluded list-wise for all remaining analyses. All variables were inspected for normal distribution and outliers.

Results

Patients (47% men; mean age: 51.5 ± 17.1) reported an average of $25.8 (\pm 50.4)$ months since the beginning of their hand pain. Regarding medication use at initial consultation, 28.8% took paracetamol, 34.8% nonsteroidal anti-inflammatory drugs, 3.0% tramadol, 6.8% strong opioids, 7.6% antidepressants, and 4.5% antiepileptics. Forty-seven percent had experienced an accident involving the hand and 52.2% had a degenerative hand disorder. 73.9% were treated surgically, and the remainder was treated conservatively.

Mean pain intensity (VAS) was $3.3 (\pm 2.5)$ at entry and $1.6 (\pm 2.1)$ at follow-up; this difference was statistically significant ($t = 8.21, p < 0.001$, Cohen's $d = 0.745$). When splitting the sample into patients with high versus low pain at entry using median split (median: 3.0), mean pain intensity for the low-pain group was $1.3 (\pm 1.2)$ at entry and $0.8 (\pm 1.0)$ at follow-up. Mean pain intensity for the high-pain group was $5.5 (\pm 1.4)$ at entry and $2.6 (\pm 2.4)$ at follow-up. Significant differences in pain intensity from entry to follow-up emerged for the low ($t = 3.57, p < 0.01, d = 0.45$) and the high-pain groups ($t = 8.90, p < 0.001, d = 1.19$). At entry, mean HADS depression score was $3.1 (\pm 3.0)$. Mean I-HLOC was $27.5 (\pm 5.9)$, mean SE-HLOC was $21.1 (\pm 5.1)$, and mean FE-HLOC was $22.7 (\pm 5.1)$. These scores are comparable to a psychosomatic rehabilitation in-patient normative sample reported in the questionnaire manual [33].

Whereas I-HLOC did not correlate significantly with SE-HLOC ($r = 0.004, p = 0.99$) or FE-HLOC ($r = -0.16, p = 0.09$), both external HLOC scales correlated significantly ($r = 0.49, p < 0.001$).

Hierarchical linear regression analyses were conducted for all dimensions of HLOC in separate analyses, first testing effects of each dimension on follow-up pain intensity, and, secondly, as interactions with initial pain intensity, both above

and beyond effects of control variables mentioned above. No HLOC dimension significantly predicted pain outcome directly as tested in separate analyses for each dimension. Neither I-HLOC ($\beta = -0.09, t(111) = -1.07, p = 0.29$) nor FE-HLOC ($\beta = -0.06, t(111) = -0.77, p = 0.44$) emerged as significant moderators of effects of initial pain intensity on follow-up pain intensity. However, a significant interaction between the SE-HLOC scale and initial pain intensity (Table 1 and Fig. 1) emerged. The interaction reflects that among patients with high initial pain intensity, those high in SE-HLOC demonstrated a better pain outcome than those low in SE-HLOC. Coefficients presented in Table 1 for variables entered in steps 1, 2, and 3 represent the first, second, and third blocks of the hierarchical regression analysis. Initial pain intensity and HADS depression remained significant in steps 2 and 3 of the model. No significant interactions emerged between initial pain intensity and either I-HLOC or FE-HLOC predicting outcome. To control for effects of reason for admission (illness or accident) and treatment procedure (operative or conservative) on pain outcome, the same analyses were conducted with these two variables in the regression model.

Discussion

The present study investigated the role of HLOC and its dimensions internal, social-external, and fatalistic-external HLOC in treatment outcome (pain intensity) of conservatively and operatively treated hand surgery patients. The main finding was that SE-HLOC moderated the effect of initial pain intensity on pain intensity at follow-up. Among patients with higher initial pain intensity, those with lower SE-HLOC experienced higher follow-up pain intensity, compared to those with higher SE-HLOC.

Whereas both external HLOC dimensions correlated significantly ($r = 0.49, p < 0.001$), I-HLOC did not correlate with either external HLOC dimensions. For these patients, believing in personal control of their health appears unrelated to believing that powerful others (e.g., medical professionals) or external factors influence one's health. Seeing one's health as controlled by powerful others seems to overlap with seeing one's health as controlled by chance. However, a correlation coefficient between both external dimensions below 0.85 indicates sufficient distinction justifying separate examinations of predictions of pain intensity outcome by SE-HLOC and FE-HLOC.

No HLOC dimension significantly predicted pain intensity at follow-up directly, contrary to our hypotheses that I-HLOC would positively and FE-HLOC would negatively predict outcome. While neither I-HLOC nor FE-HLOC significantly moderated effects of initial pain intensity on follow-up pain intensity, SE-HLOC did. Patients with high initial pain intensity and low SE-HLOC demonstrated clinical levels of pain

Table 1 Hierarchical linear regression analysis with moderation analysis predicting pain intensity at 4-month follow-up

	Pain intensity t1				ΔR^2
	<i>B</i>	SE	β	<i>t</i>	
Step 1					0.37***
Gender	0.17	0.33	0.04	0.50	
Age	0.01	0.01	0.07	0.83	
Treatment modality	-0.45	0.38	-0.10	-1.17	
Source of hand pain	0.04	0.37	0.01	0.10	
HADS—depression score	0.19**	0.06	0.26**	3.25**	
Pain intensity t0	0.41***	0.06	0.51***	6.33***	
Step 2					0.00
Social external HLOC	-0.02	0.03	-0.06	-0.73	
Step 3					0.03*
Pain intensity t0 × social external HLOC	-0.33*	0.17	-0.16*	-1.99*	

HLOC health locus of control, HADS Hospital Anxiety and Depression Scale, t0 intake, t1 4-month follow-up, SE standard error, ΔR^2 R^2 change

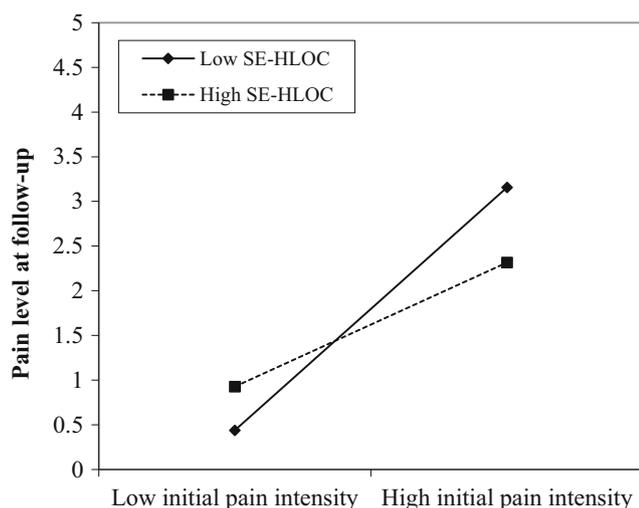
* $p < .05$, ** $p < 0.01$, *** $p < .001$

intensity at follow-up, whereas patients with high initial pain intensity and high SE-HLOC experienced lower pain intensity at follow-up. Thus, for patients with higher initial pain intensity, diminished belief that powerful others control one’s health was associated with higher pain at follow-up. SE-HLOC has emerged as a significant moderator in previous research [37–39], demonstrating health benefits for patients with higher impairment. However, this literature remains sparse. Beliefs in personal control of one’s health (I-HLOC) appear less relevant in predicting pain outcome in the present study’s treatment setting and sample. Notably, neither reason for admission (degenerative hand problems or injury) nor treatment procedure (operative or conservative) significantly predicted pain outcome. Moreover, SE-HLOC emerged as a

significant moderator, even when controlling for age, gender, depression, reason for admission, and treatment procedure.

While neither reason for admission nor treatment procedure significantly predicted pain intensity at follow-up, these aspects should nonetheless be considered as relevant patient characteristics. Future research should consider these factors as potentially influential on treatment outcome, as was done in previous research [9]. Reason for admission may differentially inform clinical decision-making, and subsequent treatment procedures may influence treatment mechanisms relevant to outcome.

Although this study’s design prohibits causal inferences, the results might imply that if patients undergoing surgical or conservative treatment for hand problems or injuries with strong initial pain can surrender control to and establish trust in their healthcare professionals (physicians, hand therapists, nurses, etc.), more favorable outcomes could be expected. Patients with greater pain may be particularly susceptible to effects of their control perception’s reactivity on their social-medical environment and vice versa. Future research may benefit from including control group testing for treatment effects, as patients with greater pain may benefit from SE-HLOC in settings where treatment relationships are being established, compared to those not receiving treatment. Patients receiving treatment, compared to no treatment, may be innately subjected to control perceptions and social patient-clinician dynamics (e.g., trust), which may influence outcome. Inter- and intrapersonal characteristics of patients actively engaging in treatment with healthcare providers may be relevant, as these dynamics may influence treatment outcome. Research indicating that patient trust in physicians and medical institutions predicts positive outcome and that patient-rated physician empathy correlates with patient satisfaction



Note. SE-HLOC = social-external health locus of control

Fig. 1 Significant interaction between the SE-HLOC scale and initial pain intensity

[40] corroborates our finding that particularly impaired patients may benefit from surrendering control to medical professionals. Future research will need to replicate these findings in other samples of hand therapy patients and examine their generalizability to other pain patient samples.

Wallston [22], author of the original MHLOC scale, recently proposed that HLOC may better be conceptualized as self-efficacy or perceived control beliefs, especially regarding I-HLOC. To our knowledge, the construct of powerful others (social-external) HLOC has not been further elaborated or addressed. A reconceptualization of this construct embedded in the notion of patient trust might facilitate its utility for patient assessment, outcome prediction, and clinical decision-making. Specifically, patients with high initial pain intensity and diminished control beliefs in their medical caretakers (i.e., doctors, hand therapists) may need special attention. Future research may benefit from implementing assessments of HLOC and patient trust with questionnaires in hand surgery settings to expand this field of research.

A few limitations are worth mentioning. First, as psychopathology and HLOC were assessed at the beginning of treatment only, future research could benefit from repeated and longer-term assessments examining associations with treatment outcomes. Second, as more recent data are not available, normative KKG data we referred to were taken from the arguably outdated original manual [33]. Internal consistency of our SE-HLOC data corresponded to that of the manual's normative sample [33]. Though considered acceptable, this questionnaire's scales leave room for improvement, so results should be interpreted cautiously. Notably, the English language equivalent's (MHLOC [32]) corresponding scale exhibits similar internal consistency and is considered reliable. Lastly, implications of relationships discovered in the present study are restricted to patients in treatment; we cannot generalize effects of these beliefs to patients not receiving treatment.

The present study provides novel insight into the role of HLOC in pain behavior of patients undergoing hand surgery treatment. Notably, SE-HLOC moderated the progression of pain over the course of 4 months. Patients with high initial pain may benefit from surrendering control to and developing trust in healthcare professionals. Assessment of initial control beliefs may benefit clinical decision-making. Whether interventions targeting SE-HLOC in patients with high pain intensity entering hand surgery centers may benefit treatment outcome awaits further research.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflicts of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the

institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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