Article

Implemented New Technologies within the Complexity of Medical Rehabilitations: Improvement of Mental Health and Synergetic Outcomes with Healthcare Service Effects

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Abstract: The need for new technologies into healthcare services has been stressed. However, little is known about the effectiveness of digital interventions integrated in psychosomatic rehabilitation processes. Data from 724 patients from psychosomatic rehabilitation clinics were analyzed for effectiveness of digital trainings examined by a change in symptoms related to depression, anxiety, stress and loneliness from pre- to post-rehabilitation. Rehabilitation satisfaction was examined in association with reaching rehabilitation goals and satisfaction with communication. Mixed repeated measures analysis of covariances, analysis of covariances, and hierarchical stepwise regression analyses were performed. Results indicated a superior effectiveness for the intervention group receiving all offered digital treatments in addition to the regular face-to-face rehabilitation program with regard to symptoms of depression, $F(2,674)=3.93$, $p<.05$, $\eta_P^2=.01$), and anxiety, $F(2,678)=3.68$, $p<.05$, $\eta_P^2=.01$), post-rehabilitation with large effect sizes for both depression ($d=1.28$) and anxiety ($d=1.08$). In addition, rehabilitation satisfaction was positively associated with reaching rehabilitation goals and perceived communication with healthcare workers. Digital interventions appeared effective in supporting mental health of psychosomatic rehabilitation patients post-rehabilitation. This finding supports the inclusion of multidisciplinary and interdisciplinary digital and face-to-face treatment programs and call for more implementations of new technologies in a context of complexity to improve health and healthcare service.

Keywords: mental health; psychosomatic rehabilitation; internet delivered digital trainings; multidisciplinary and interdisciplinary interventions

1. Introduction

Mental Health and the COVID-19 Pandemic

The effects of the coronavirus disease 2019 (COVID-19) on individuals' health, especially on mental health and perceived well-being are likely to be profound and long-lasting [1]. Not only has the COVID-19 pandemic lead to rapid changes in human interaction, hygiene behavior, communication behavior and self-care, but it has also led to increased feelings of uncertainty, distress, and social isolation resulting in stress reactions, symptoms of depression and anxiety, and general fear of the virus [2]. Several studies have pointed out that elevated rates of depression, anxiety, stress as well as post-traumatic stress were associated with the COVID-19 pandemic [3]. Therefore, in case of a prolongation of restriction measures, individuals, especially those who are already susceptible of a mental health disorder, may develop serious mental health issues [4,5].

For individuals with a pre-existing mental health disorder, the lockdown measures have shown to be major stress factors that are associated with a deterioration of their mental health status due to changes in daily routine and social rhythms [5], reduced access to

support services, earlier discharge from psychiatric units or discontinuation of psycho-therapy treatments [6–8].

To partially compensate for reduced access to support systems and discontinuation of psychotherapy, therapists have been more prone to offer digital psychotherapy sessions in addition to face-to-face sessions to guarantee the continuation of treatment as well as to protect and support the mental health of patients. The idea of blended psychotherapy as a combination of online treatments with face-to-face psychotherapy is rather a new research field and has received more attention during the COVID-19 pandemic [9–12]. Blended psychotherapy has shown to provide many advantages over face-to-face psychotherapy as it supports bridging distances between residence and treatment placement, flexibility, as well as increased patient empowerment [13,14].

However, even though a few studies have examined the effectiveness of blended psychotherapy in outpatient settings [15], the effectiveness for integrating digital interventions in form of a blended psychotherapy concept into medical, psychosomatic rehabilitation treatment programs is yet to be evaluated.

Therapy for Medical, Psychosomatic Rehabilitation Patients

The overarching aim of the rehabilitation system in Germany is to reintegrate and support social participation of patients but not to curate disorders. Patients admitted to rehabilitation clinics in Germany are usually treated on the basis of the biopsychosocial model [16]. This is in contrast to patients with severe mental health disorders who are typically seen by a psychiatrist and are potentially being admitted to a psychiatric hospital and treated by an interdisciplinary and multidisciplinary team according to the German national regulations and guidelines. Hence, rehabilitations are usually in-patient rehabilitations providing psychoeducation, psychotherapy in from of individual and group therapy, physical therapy and occupational therapy as well as trainings of skills relevant for the reintegration and return to work (RTW) [17].

Research has shown that blended therapy can be well integrated in the preparatory process before a rehabilitation stay [18], during the rehabilitation process at the rehabilitation clinics itself [19], and for aftercare and stabilization [20]. First attempts to provide patients with digital support after rehabilitation have already been made by the Curriculum Hannover Online [21] and the internet- and mobile-based intervention (IMI) DE-RENA [22]. However, so far, no study has attempted to evaluate digital trainings offered before as well as during medical, psychosomatic rehabilitation.

Importance of Communication in Medical, Psychosomatic Rehabilitation Treatment Programs

Communication is the central element of psychotherapy. Based on patient's verbal and nonverbal communication, psychotherapists are able to foster a diagnostic-therapeutic alliance with the patient [23–25]. Additionally, the therapist is encouraged to promote effective communication strategies tailored to the individual patients in order to understand maladaptive behaviors and to support the patient with treatment options and coping skills [26].

An example of communication skills required in the healthcare context has been proposed by Rider & Keefer [27]. In the study, the authors highlight the importance to communicate effectively with patients by focusing on the interpersonal relations. Hence, healthcare professionals are encouraged to communicate clearly, accurately and providing the patient with sufficient information by also acknowledging the patient's individual situation. However, with regard to the setting of a medical, psychosomatic rehabilitation treatment, the exact association between perceived effectiveness of communication from the patients' perspective and rehabilitation effectiveness as well as satisfaction has so far not been evaluated.

Compensatory Carry-Over Action Modell

The Compensatory Carry-Over Action Modell (CCAM) describes how health outcomes such as a decrease in symptoms of depression and anxiety or perceived loneliness and stress result from different health related behaviors such as participation in digital trainings or changes in lifestyle behaviors such as physical exercise. In addition, the CCAM assumes that relevant, higher-order goals such as participation may be achieved by implementing goals for individual health related behaviors through the use of action plans. Important for the transfer between the individual behaviors (i.e. participation in digital trainings and reduced mental health symptoms) are personal psychological resources [28]. The psychiatrist fosters an early diagnostic-therapeutic alliance with the patient and integrates information obtained through both the patient's verbal and nonverbal communication and his or her own countertransference [23, 24].

Goal of the Study

The goal of the current study was to test the effectiveness of digital trainings provided to rehabilitation patients before and during their rehabilitation stay. In addition, as communication is a central element of (psycho)therapy, the present study aimed to evaluate the interrelation of communication with rehabilitation satisfaction and consequently with perceived rehabilitation success.

With these research aims in mind and on basis of the theoretical background of the CCAM and previous findings, the following hypothesis were formulated: 1) Symptoms of depression, anxiety, perceived stress, and loneliness will decrease from pre- to post-rehabilitation. Additionally, we expected that 2) the intervention group who received all digital trainings will have a more substantial decrease of symptoms with regard to depression, anxiety, perceived stress, and loneliness. Further, we assume that 3) the patients from the intervention group receiving all digital trainings will indicate a higher perceived rehabilitation success. We also predicted that 4) patients who perceived greater satisfaction with communication also are more satisfied with their rehabilitation process and will more likely indicate to have achieved their rehabilitation goals.

2. Materials and Methods

Study Design

The present study was conducted at four psychosomatic rehabilitation clinics from the Dr. Becker clinic group in a longitudinal manner. Participants recruited by the clinics for this study received regular treatment programs with regard to psychological and physical interventions. Those treatment programs included among others individual and group psychotherapy, physiotherapy, as well as occupational therapy.

Recruitment and Data Collection

Participants were recruited through the four participating clinics from the Dr. Becker clinic group. Before participation, patients were informed about the study in writing on the rehabilitation clinic group's online portal. Thereby, it was guaranteed that only patients who had access to the digital portal with an individualized participant code could participate. Patients were invited to take part in a survey administered via the survey platform Unipark. Before participating in the survey, patients were asked to read the participation information and were asked to give informed consent. All data collected as part of this study were pseudonymized. Participants were not offered any form of compensation for participating in the study. The survey at the four psychosomatic clinics was administered between July 2020 and June 2021. Data collection was longitudinal with two measurement time points. Patients were invited to participate up to six weeks before start-

ing their rehabilitation stay (T1) as well as after their rehabilitation stay (T2). Participation after rehabilitation was possible for a maximum of 12 weeks post-rehabilitation. Reminders were sent out to the participants for the T2 survey after 1, 4, and 11 weeks. Ethical approval for the online survey concerning psychosomatic rehabilitation patients was given by the Ethics Committee at Jacobs University Bremen (protocol code 2020_09 and date of approval: 25.06.2020). The current study was conducted as part of the project "AN-HAND-COVID19 - Offer to achieve treatment and rehabilitation goals in compliance with hygiene and social-distancing rules" (ClinicalTrials.gov Identifier: NCT03855735), which is supported by the Dr. Becker clinic group.

Participants

N=1279 patients participated in the online survey at timepoint 1 (before rehabilitation stay). A total of 555 patients dropped out after baseline assessment leaving 724 participants who completed the survey at measurement timepoint 1 pre-rehabilitation and the survey at measurement timepoint 2 post-rehabilitation.

The most common three diagnoses that patients received were, according to the International Classification of Disease-10 (ICD-10) manual, a recurrent depressive disorder, current episode moderate (F33.1) with n=193 (26.7%), an adjustment disorders (F43.2) with n=159 (22.0%), and a moderate depressive episode (F32.1) with n=93 (12.8%). Patients age ranged from 18 to above 60 years. 466 (64.4%) patients were female. 155 (21.7%) patients had a secondary school diploma, 106 (14.8%) patients had a high school diploma, 319 (44.6%) patients had completed vocational training, and 135 (18.9%) patients indicated to have a university degree.

Interventions

As part of the incoming process and prior to the begin of the treatment stay, participants were asked to participate in a digital training on rehabilitation goals presented to patients in a digital power-point presentation without face-to-face elements. Participation was on a voluntary basis. The digital training on rehabilitation goals could be accessed from home with a computer, laptop, tablet or smartphone. This training was designed as a combination between psychoeducation and practical elements. Patients were educated on the importance of formulating goals and plans as well as on how to formulate those. After the educative element, participants were instructed to formulate own plans for their rehabilitation treatment process. Further interactive tools such as digital exercise booklets supporting goal and plan formulation were provided to patients online. Patients were encouraged to make use of the supporting material after the training.

As part of the rehabilitation process, participants diagnosed with a depressive episode or disorder were required to take part in the digital group training for depression. The digital group training was based on cognitive behavioral therapy (CBT) guidelines with evidence-based components of computerized cognitive behavioral therapy (eCBT) and internet-delivered cognitive behavior therapy (iCBT) interventions [29–31]. The group therapy for depression was conducted in a flipped classroom manner with a combination of digital and face-to-face components. The digital group therapy for depression was divided into six therapy sessions. Each session lasted for about 50 minutes. The 50-minute sessions were divided into a five-minute digital training followed by a 45-minute analog group session. Contents discussed during the group sessions were for example psychoeducation on the symptoms of and coping mechanisms for depression, underlying models as well as different available treatments such as drug therapy and ambulatory or stationary psychotherapy.

The informative digital training on legal rights for (severely) disabled was offered to all patients once during their rehabilitation stay in form of a group session. Participation was mandatory irrespective of the ICD-10 diagnosis. The training consisted of a 20-minute informative video and a subsequent 25-minute face-to-face group session in which in-

depth questions were discussed in accordance with the flipped classroom. Contents of the video and the group discussion included aspects of the law on severe disabilities, requirements for obtaining a degree of disability and its consequences on everyday life.

Hence, Participants allocated to the control group received the care-as-usual rehabilitation program. Patients allocated to intervention group 1 (IG1) took part in the digital training on rehabilitation goals prior to the rehabilitation stay and in addition to the care-as-usual rehabilitation program. As part of intervention group 2 (IG2), patients took part in the digital training on rehabilitation goals prior to the rehabilitation stay as well as in the digital group therapy on depression and digital training on legal rights for (severely) disabled in addition to the regular care-as-usual rehabilitation treatment.

Instruments

Depressive Symptoms and Symptoms of Anxiety

To measure symptoms of depression and anxiety, the Patient Health Questionnaire-4 (PHQ-4) was used. The questionnaire was not used as a diagnostic tool as part of this study, but rather used as a measure of symptom intensity. The PHQ-4 is a composite measure with four items of the PHQ-2 [32] and the GAD-2 [6-7]. All four items are measured on a four-point Likert scale from 0 ('not at all') to 3 ('nearly every day'). A scale sum score of ≥3 for both the PHQ-2 (T1 Spearman's rho=.70; T2 Spearman's rho=.71) and the GAD-2 (T1 Spearman's rho=.64; T2 Spearman's rho=.67) depicts the cut-off value between the normal range and a probable case of depression and anxiety [33,35].

Perceived Stress

As a measure of stress, the Perceived Stress Scale (PSS; [36]) was used. The PSS is a globally used self-report scale measuring perceived stress. With regard to the current study, perceived stress was measured by the short four-item version of the PSS scale (PSS-4; [37]). The PSS-4 assesses perceived stress on a 5-point Likert scale from 0 ('never') to 4 ('very often') with a Cronbach's alpha at T1 of .71 and at T2 of .85.

Loneliness

Perceived loneliness was assessed by means of two items: 'How often do you feel lonely?' stemming from the Center for Epidemiologic Studies–Depression (CES–D) Scale [38] and 'How often do you feel unhappy to be alone?' from the UCLA Loneliness Scale [39] (T1 Spearman's rho=.81, T1 Spearman's rho=.81). Both items were measured on a four-point Likert scale from 1 ('not at all') to 4 ('almost every day').

Rehabilitation Goals

Before and after rehabilitation, patients were asked to indicate whether they aimed to achieve eight possible rehabilitation goals on a scale from 1 ('not at all') to 4 ('completely') with a Cronbach's alpha at T1 of .65 and at T2 of .89. Examples of possible rehabilitation goals included the reduction of mental health symptoms, an improvement of stress coping capabilities, improvement of cognitive abilities, ability to relax and rest or the improvement of/ return to past earning capacities. The items assessing rehabilitation goals were developed based on the provided content and the outcome aims of the digital trainings provided before and during the rehabilitation treatment.

Perceived communication

Perceived communication between rehabilitation patients and healthcare professionals (i.e., psychotherapists, occupational therapists, doctors, nurses or other healthcare

staff) was examined from the perspective of rehabilitation patients through six items developed based Rider and Keefer's interpersonal communication competencies with a Cronbach's alpha of .88 [27].

Satisfaction with rehabilitation

Post rehabilitation, patients were asked to indicate their satisfaction with rehabilitation with one item on a six-point Likert scale from 1 ('very dissatisfied') to 6 ('very satisfied').

Statistical Analyses

For all analyses, SPSS Version 27 was used. The data were analyzed using 724 patients who were either allocated to the control group or to the intervention groups (IG1 to IG2). A randomization check was performed to confirm successful allocation to groups. Hence, the different groups (control group and two intervention groups) were compared for age, gender, educational status, symptoms of depression and anxiety, perceived stress and perceived loneliness before rehabilitation. Therefore, a one-way ANOVA was used for continuous variables. Chi-squared tests were used for nominal variables. According to Tabachnick and Fidell [40], it has been suggested that in case of a significant difference, correlations between the significant variable and the dependent variable were to be computed to assess whether the significant variable should be included as a covariate in our analyses.

As the amount of missing data was below 5% for all items, no imputation of missing data was performed. Patients with missing data on the social-cognitive variables (i.e., age or gender) were included for further analyses if they had at least one non-missing data point under the assumption of missing (completely) at random.

To evaluate significant changes in the symptom intensity with regard to depression, anxiety, stress and loneliness, a 2x3 linear mixed-model repeated measures analysis of covariances (MMRM ANCOVA) was performed. In order to explain a significant time x intervention group interaction effect, mean difference scores for the two time points were computed (before rehabilitation to after rehabilitation). Based on the mean difference scores, a series of analyses of covariances were performed to identify differences between interventions.

To determine the effect sizes of all measurements, partial eta squared and Cohen's d values were computed. Based on the recommendation by Field [41], partial eta squared values of 0.01, 0.06, and 0.14 represent weak, moderate and strong effects [42,43]. Cohen's d values of 0.20, 0.50, and 0.80 represent small, medium, and large effect sizes [42].

Further, we performed several multivariate analyses of covariances (MANCOVA) to evaluate which treatment group was more likely to reach the proposed rehabilitation goals. Additionally, we investigated the association between the estimation of achieving rehabilitation goals and overall satisfaction with rehabilitation treatment by means of a stepwise hierarchical linear regression.

3. Results

3.1. Randomization Check

With regard to the current study, n=55 (7.6%) patients did not participate in any of the three digital trainings and were thus defined as the control group. 570 (78.7%) patients participated in the digital trainings on rehabilitation goals (intervention group 1 – IG1), and 80 (11.0%) patients participated in all three digital trainings (intervention group 2 – IG2). 19 patients (2.6%) were excluded from the analyses.

There were no significant differences for gender, X^2(2, n=701)=1.60, p=.45, for age X^2(8, n=703)=11.84, p=.16, and for educational level X^2(6, n=696)=2.80, p=.83. In addition, there

were no significant differences for symptoms of depression $F(2,695)=0.78$, $p=.46$, $\eta_P^2=.01$, for symptoms of anxiety $F(2,698)=1.15$, $p=.32$, $\eta_P^2=.01$, as well as for perceived stress $F(2,695)=1.61$, $p=.20$, $\eta_P^2=.01$, and perceived loneliness $F(2,686)=1.22$, $p=.30$, $\eta_P^2=.01$.

3.2. MMRM ANCOVA from before Rehabilitation Treatment to after Rehabilitation Treatment

Results indicated a significant main effect across time, controlling for age and gender for symptoms of depression, $F(1,674)=13.34$, $p<.01$, $\eta_P^2=.02$, symptoms of anxiety $F(1,678)=6.80$, p<.01, $\eta_P^2=.01$, and perceived stress $F(1,672)=17.63$, $p<.01$, $\eta_P^2=.03$ as well as for perceived loneliness $F(1,662)=4.00$, $p<.05$, $\eta_P^2=.01$).

Significant interaction between time x intervention controlling for age and gender and intervention group emerged for symptoms of depression $F(2,674)=3.93$, $p<.05$, $\eta_P^2=.01$) and symptoms of anxiety $F(2,678)=3.68$, $p<.05$, $\eta_P^2=.01$). However, no significant interaction effect was found for perceived stress $F(2,672)=1.80$, p=.17, $\eta_P^2=.01$) as well as for perceived loneliness $F(2,662)=2.69$, p=.07, $\eta_P^2=.01$).

No significant main effect for intervention, controlling for age and gender was found for all four outcome domains: Depression $F(2,774)=0.58$, $p=.56$, $\eta_P^2=.01$, anxiety $F(2,678)=0.42$, $p=.66$, $\eta_P^2=.01$, perceived stress $F(2,672)=0.832$, $p=.44$, $\eta_P^2=.01$, and loneliness $F(2,662)=1.43$, $p=.24$, $\eta_P^2=.01$. Reported effect sizes for the main effects of time and intervention as well as for the interaction effect of *time x intervention* were small for all outcome domains.

3.3. Changes in Mental Health Symptoms with regard to Intervention Group from before Rehabilitation Treatment to after Rehabilitation Treatment

Overall, average scores showed an improvement from pre-rehabilitation treatment to post-rehabilitation treatment with regard to symptoms of depression, symptoms of anxiety, and perceived stress across the control group and intervention group (see Figure 1a-d). For perceived loneliness, however, a reduction in perception was found for intervention group 1 and 2, but not for the control group.
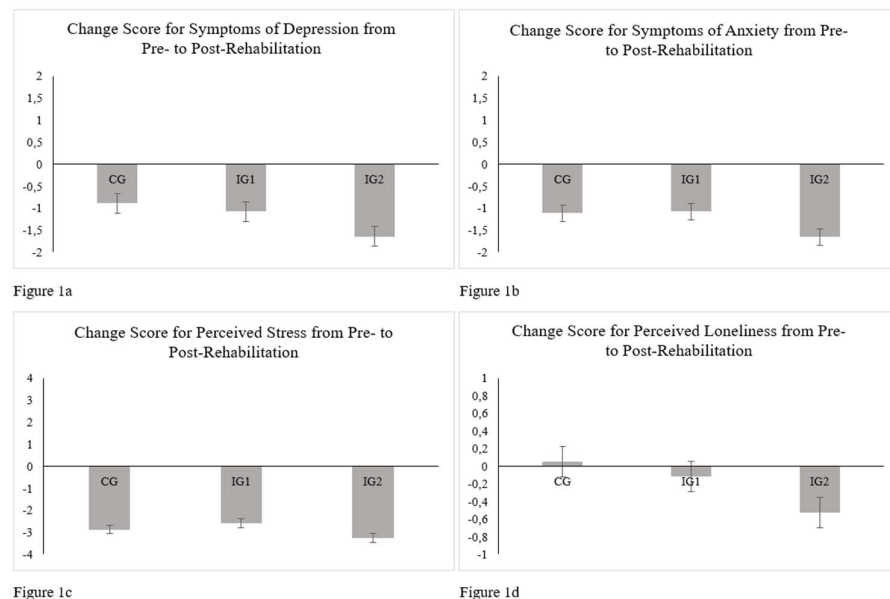

Figure 1a

Figure 1b

Figure 1c

Figure 1d

Figure 1 (a-d). Estimated marginal means for symptoms of depression (Figure 1a), symptoms of anxiety (Figure 1b), perceived stress (Figure 1c), and perceived loneliness (Figure 1d). Error bars are represented by standard errors of the mean. Higher negative scores

represent a greater reported symptom change from pre- to post-rehabilitation and thus, a better mental health status post-rehabilitation.

The results of the ANCOVA showed significant between group differences with regard to the decrease in symptoms in the outcome domains from pre-rehabilitation to post-rehabilitation. Hence, significant differences were found for symptoms of depression $F(2,638)=4.50$, $p<.05$, $\eta_P^2=.02$ and symptoms of anxiety $F(2,638)=4.19$, $p<.05$, $\eta_P^2=.02$, however, not for perceived stress $F(2,638)=2.38$, $p=.09$, $\eta_P^2=.01$ and perceived loneliness $F(2,638)=2.39$, $p=.09$, $\eta_P^2=.01$.

Bonferroni's post-hoc test indicated a significant difference the KG and IG2 ($M_{diff}=-.74$, $p=.40$) and a significant difference between IG 1 and IG2 ($M_{diff}=-.55$, $p=.02$) for symptoms of depression. With regard to symptoms of anxiety, Bonferroni's post-hoc test indicated a significant difference between IG1 and IG2 ($M_{diff}=-.58$, $p=.02$).

Looking at mean scores in Table 1, this effect is highlighted by the results for depression and anxiety of the IG2 group reporting a significant decreased symptoms intensity post-rehabilitation. In addition, the average symptoms for perceived stress and perceived loneliness post-rehabilitation were lowest in intervention group two. These results suggest an improved mental health especially for intervention group three.

Table 1. Descriptive statistics (estimated marginal means [M], and standard deviations [SD]) for treatment outcomes for all treatment groups from pre-rehabilitation to post-rehabilitation (N=705)

Measure	Group	Pre-treatment *M* (SD)	Post-treatment *M* (SD)
Symptoms of Depression			
	CG	3.48 (1.87)	2.59 (1.70)
	IG1	3.43 (1.63)	2.33 (1.68)
	IG2	3.67 (1.51)	2.01 (1.08)
Symptoms of Anxiety			
	CG	3.73 (1.74)	2.61 (1.69)
	IG1	3.56 (1.63)	2.47 (1.66)
	IG2	3.83 (1.56)	2.24 (1.36)
Perceived Stress			
	CG	9.84 (2.83)	7.00 (3.35)
	IG1	9.35 (2.31)	6.78 (3.27)
	IG2	9.68 (2.04)	6.45 (2.96)
Perceived Loneliness			

Measure	Group	Pre-treatment	Post-treatment
		M (SD)	*M* (SD)
	CG	4.51 (1.74)	4.54 (1.66)
	IG1	4.29 (1.63)	4.17 (1.66)
	IG2	4.56 (2.00)	4.13 (1.64)

Note. CG=control group (n=55; no digital intervention except regular rehabilitation treatment), IG1=intervention group 1 (n=570, in addition to regular rehabilitation treatment participation in digital rehabilitation goals), IG2=intervention group 2 (n=80, in addition to regular rehabilitation treatment participation in digital rehabilitation goals, digital group therapy on depression, and on legal rights for (severely) disabled).

3.4. Effect Sizes

Effect sizes were estimated for outcome domains of symptoms of depression, anxiety and perceived stress between measurement time points (pre- and post-rehabilitation) and for group comparison purposes post-rehabilitation. From pre- to post-rehabilitation, Cohen's *d* values indicated a medium effect for overall symptoms of depression (0.69) and symptoms of anxiety (0.69). From pre- to post-rehabilitation the effect size Cohen's *d* values, taking the intervention and control group into consideration, for depression was significantly larger in the IG2 group (1.27) compared to the IG1 group (0.66) and to the control group (0.31). For symptoms of anxiety Cohen's *d* values were significantly larger in the IG2 group (1.08) than in the IG1 group (0.66).

3.5. Association between reaching rehabilitation goals post-rehabilitation and satisfaction with rehabilitation post-rehabilitation

To evaluate the association between reaching rehabilitation goals post-rehabilitation and satisfaction with rehabilitation treatment, a stepwise hierarchical regression analysis was performed controlling for age and gender and intervention group. Results underlined that patients who indicated to have achieved the following rehabilitation goals also were more satisfied with the overall rehabilitation treatment process: reduction of psychological symptoms (b=.20, *p*<.01), improvement of physiological status (b=.14, *p*<.01), relaxation and resting (b=.14, *p*<01), improvement of coping with stress and management of stress (b=.12, *p*<.05), and improvement of one's own confidence (b=.11, *p*<.05; see Table 2). However, results showed a non-significant difference between treatment groups associated with the estimation of reaching rehabilitation goals post-rehabilitation, $F(16,1314)=1.524$, *p*=.08, η_P^2=.02. In addition, no significant differences regarding satisfaction with rehabilitation treatment were found between intervention groups, $F(2,682)=0.02$, *p*=.98, η_P^2=.01.

3.6. Association between perceived communication and satisfaction with rehabilitation post-rehabilitation

To evaluate the association between perceived effectiveness of communication and satisfaction with rehabilitation treatment post-rehabilitation, a hierarchical stepwise regression was performed controlling for age, gender and the intervention groups. Results showed that rehabilitation patients who indicated higher effectiveness of communication were also more satisfied with their rehabilitation treatment on the following communication dimensions: early enough discussion on treatment steps and plans (b=.22, *p*<.01), taking worries and fears seriously (b=.25, *p*<.01), and provision of sufficient information

(b=.12, p<.05). The covariates intervention group (b=.01, p=.91), age (b=.01, p=.98), and gender (b=.02, p=.47) were not significantly associated with the relationship between perceived communication and satisfaction with treatment (see Table 3).

Table 2. Step-wise hierarchical regression results: Satisfaction with rehabilitation post-rehabilitation as a predictor in n=663 rehabilitation patients.

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	ß	*p*	ß	*p*	ß	*p*	ß	*p*	ß	p	ß	*p*
Age	.07	.09	.05	.12	.05	.17	.04	.25	.03	.37	.02	.46
Gender	.05	.23	.06	.06	.07	.05	.07	.03	.07	.03	.07	.03
Intervention Group	-.01	.84	-.03	.32	-.02	.55	-.02	.51	-.02	.61	-.03	.45
Reduction of psychological symptoms	-	-	.50	<.01	.38	<.01	.27	<.01	.23	<.01	.20	<.01
Improvement of physiological status	-	-	-	-	.22	<.01	.18	<.01	.15	<.01	.14	<.01
Improvement of coping with stress and management of stress	-	-	-	-	-	-	.19	<.01	.16	<.01	.12	.01
Relaxation and resting	-	-	-	-	-	-	-	-	.15	<.01	.14	<.01
Improvement of one's own confidence	-	-	-	-	-	-	-	-	-	-	.11	.01
R^2		.01		.26		.29		.31		.32		.33

Note. ß-values are represented as standardized coefficients. Age was categorized into below 29 years of age, 30-39 years of age, 40-49 years of age, 50-59 years of age and above 60 years of age. Gender was categorized into male and female.

Table 3. Step-wise hierarchical regression results: Satisfaction with rehabilitation post-rehabilitation as a predictor in n=641 rehabilitation patients.

	Model 1		Model 2		Model 3		Model 4	
	ß	*p*	ß	*p*	ß	*p*	ß	*p*
Age	.05	.24	.02	.50	.01	.78	.01	.98
Gender	.04	.29	.01	.76	.02	.55	.02	.47
Intervention Group	-.01	.89	.01	.89	.01	.78	.01	.91
Taking worries and fear seriously	-	-	.48	<.01	.29	<.01	.25	<.01
Early enough discussion on treatment steps and plans	-	-	-	-	.28	<.01	.22	<.01
Sufficient provision of information	-	-	-	-	-	-	.12	.03
R²		.01		.24		.28		.29

Note. ß-values are represented as standardized coefficients. Age was categorized into below 29 years of age, 30-39 years of age, 40-49 years of age, 50-59 years of age and above 60 years of age. Gender was categorized into male and female.

4. Discussion

The present study assessed the decrease in symptoms of depression, anxiety, perceived stress and loneliness from pre- to post rehabilitation by also evaluating the effectiveness of different digital trainings offered to medical, psychosomatic rehabilitation patients with regard to symptom reduction in the aforementioned mental health outcome domains. Furthermore, this study also assessed the association between perceived effectiveness with communication and satisfaction with the rehabilitation process as well as with having achieved rehabilitation goals.

Reduction in mental health related symptoms and the effectiveness of different digital trainings

Previous research has already indicated that the rehabilitation process is able to support symptom reduction in patients form a medical, psychosomatic clinic [44–46]. This is in line with our results, highlighting that symptoms of depression, anxiety, stress as well as perceived loneliness decreased significantly from pre- to post-rehabilitation irrespective of intervention or control group. These findings provide insight that offering psychotherapy in addition to regular interventions, such as occupational therapy, relaxation, and physiotherapy, supports the symptom reduction of not only ICD-10 diagnoses such as depression and anxiety but also of symptoms associated with ICD-10 diagnoses, as perceived stress and loneliness. The results were significant irrespective of patients' age or gender.

However, when examining the interaction effect between symptom change over time and intervention, significant differences were only found with regard to symptoms of depression and anxiety. It may be postulated that reducing symptoms of stress and loneliness are not the central goal of the German medical, psychosomatic rehabilitation system and treatment process as stress and loneliness are not considered as an ICD-10 diagnosis. The overall treatment process is formulated on that basis of the theoretical biopsychosocial model of the International Classification of Functioning, Disability and Health (ICF) and with consideration of the ICD-10 diagnosis. Hence, complaints are, thus, translated by diagnostic tests into diagnoses, which are necessary and a prerequisite for the treatment process [16,47]. Consequently, symptoms of stress and loneliness may not be specifically targeted by the different digital interventions offered in addition to the regular treatment process. It may be suggested, that as loneliness and stress are central sustaining factors for depression and anxiety, the digital interventions should be adapted to also reduced these symptoms respectively.

With regard to the effectiveness of different digital trainings offered during rehabilitation, results have highlighted that for patients receiving different combinations of digital trainings (i.e. training on rehabilitation goals and training on legal rights for (severely) disabled) an average symptom reduction was found for depression, anxiety and perceived stress. We found the same for participants part of the control group as well. However, perceived loneliness did not decrease for patients as part of the control group. Hence, the present results would suggest a beneficial effect of the rehabilitation setting especially with regard to depression, anxiety, and perceived stress. These findings are consistent with previous finding [44–46].

This has been especially pronounced when comparing the patients allocated to the control group with patients from the intervention group one (digital rehabilitation goals) as well as patients from the intervention group one with participants from intervention group two (digital rehabilitation goals, group therapy on depression, and digital training on legal rights for (severely) disabled) concerning the symptom reduction in depression. With regard to the symptom reduction in anxiety, this effect was significant when comparing intervention group one with intervention group two. Hence, intervention group two has shown to be significantly superior with regard to symptom reduction concerning depression and anxiety. Considering the symptom reduction of perceived stress and perceived loneliness intervention group two has shown to be on average superior to either

intervention group one or the control group. These findings indicate that the interdisciplinary and multidisciplinary medical, psychosomatic rehabilitation program as a whole had a positive impact on the mental health status, a finding adding to previous research [48,49]. However, the long-lasting effects of the interdisciplinary rehabilitation program have not been analyzed as part of this study and will need to be considered when assessing stabilization of mental health and return to work (RTW) after rehabilitation. Hence, further research is necessary to evaluate the mentioned research questions and to validate the results of the present study.

Interpretation of effect sizes

So far, effect size benchmarks have only been postulated for regular face-to-face treatment but not for digital trainings as part of a medical, psychosomatic treatment process. Previous literature has defined effect size benchmarks for psychologically based treatment programs from pre- to post-treatment stay [44,50]. As part of the study, the authors have suggested average effect sizes across different measurement domains, among others for depression, to be at 0.35 which has been recommended to be used for the assessment of treatment programs. In the present study, the pre- to post-treatment effect sizes (Cohen's d) for outcome variables (i.e. symptoms depression (0.69) and symptoms of anxiety (0.69) were revealed to be of medium effect size. Effect sizes across all symptom outcome domains were largest in the IG2 group, i.e. Cohen's d for depression 1.27 and for anxiety 1.08. Therefore, our results are in line with the proposed effect size benchmarks by Fenton & Morley [50] and Liebherz & Rabung [44]. Hence, future research should focus on recommending effect size benchmarks for digital trainings in a medical, psychosomatic rehabilitation setting.

Rehabilitation Goals

Results stressed that patients who perceived greater satisfaction with rehabilitation goals (i.e. reduction of psychological symptoms, improvement of physiological status, relaxation and resting, improved stress coping capabilities, improvements in own confidence and self-esteem) also displayed greater satisfaction with the overall rehabilitation treatment process. Additionally, patients who were more satisfied with their treatment also perceived greater satisfaction with communication (i.e. early discussions on treatment steps and plans, taking patients' worries and fears seriously, providing sufficient information). However, no significant difference was found with regard to intervention groups. These results are in line with previous literature on the potentials of telemedicine generally and especially in times of crisis like during the corona pandemic [6].

Limitations and Suggestions for Future Research

One of the main limitations of the current study is that we had no indication of the mental health status of psychosomatic rehabilitation patients before the outbreak of the COVID-19 pandemic. Hence, we cannot be certain whether the COVID-19 pandemic was associated with an aggravated symptom increase with respect to symptoms in depression, anxiety, stress and loneliness as shown by previous literature [46,51]. A further limitation that needs to be discussed is that participation in the digital training on rehabilitation goals and in legal rights for (severely) disabled was on a voluntary basis. Hence, it may have occured that patients who were especially motivated to work on their symptoms and benefit from the treatment procedures offered during the rehabilitation stay also participated in more digital interventions. Therefore, future studies should also consider motivational factors. In addition, this study did not consider possible confounding correlations of physiological symptoms (i.e. disabilities, chronic pain, cancer related illness or a potential COVID-19 infection) with the mental health status. Another limitation that needs to be considered is that the digital trainings offered before and during the rehabilitation stay

so far have not been validated or standardized but rather align with the German regulations for rehabilitation treatments as well as being developed based on experiences by the rehabilitation clinics. Hence, with regard to future research a standardized manual, such as Curriculum Hannover for aftercare [52], should be developed to effectively integrate standardized and evaluated digital trainings into the rehabilitation treatment process.

5. Conclusions

The finding of this study suggests that medical, psychosomatic rehabilitation is effective in reducing symptoms related to mental health disorders. By providing new technologies i.e. digital elements as part of the healthcare services and the treatment process, symptoms of depression, anxiety, perceived stress, and perceived loneliness could be reduced post-rehabilitation. This is especially the case with multidisciplinary and interdisciplinary rehabilitation treatment program, i.e. a treatment program including digital rehabilitation goals, digital group therapy for depression, and a digital training on legal rights for (severely) disabled. They have shown to be especially effective with regards to symptom reduction of depression and anxiety which are central goals of the medical psychosomatic rehabilitation process. Furthermore, greater satisfaction with the rehabilitation process was associated with the perception of rehabilitation goals as well as with greater satisfaction with communication between patients and healthcare professionals.

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