RESEARCH ARTICLE

Combined sport and exercise program versus aerobic exercise training in major depressive disorder: A quasi-randomized evaluation study

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ABSTRACT

Objective: The positive effect of sport and exercise interventions in the treatment of Major Depressive Disorder (MDD) is well documented for aerobic exercise interventions while other kinds of exercise prescriptions have rarely been investigated. Therefore, Weigelt and colleagues provided recommendations for the sport and exercise therapy to treat MDD.

Methods: This study was conducted as a quasi-randomized evaluation study in a pre-test/post-test design to compare the effectiveness of two different interventions (single-handed aerobic exercise *vs.* combined sport and exercise approach) on psychiatric outcome parameters in a day clinic psychiatric setting. N=62 participants took part in the study and were quasi-randomized to one of the two conditions. Affective, cognitive, psychosocial, and neuropsychological changes, were assessed by a battery of questionnaires before (t1) and after (t2) treatment. Accelerometers were used to assess kcal consumption.

Results: The results show similar treatment effects for both programs in the treatment of MDD.

Conclusion: These findings highlight the effectiveness of different physical activities in the treatment of MDD and provide further information for good clinical practice.

Keywords: Depression; Sport and exercise therapy; Outpatient treatment

Abbreviations: AEG: Aerobic Exercise Group; BDI II: Beck Depression Inventory; BSE: Body Self-Esteem Scale (Multidimensional Self-Esteem Scale); CEG: Combined Exercise Group; ESE: Emotional Self-Esteem Scale (Multidimensional Self-Esteem Scale); Flei: Subjective Evaluation of Mental Performance Scale; GSE: General Self-Esteem Scale (Multidimensional Self-Esteem Scale); HCS: Handling Criticism Scale (Multidimensional Self-Esteem Scale); MDD: Major Depressive Disorder; MSES: Multidimensional Self-Esteem Scale; NBI: Negative Body Image (Questionnaire on Body Image); PAS: Physical Attractivity Scale (Multidimensional Self-Esteem Scale); PBS: Performance Based Self-Esteem Scale (Multidimensional Self-Esteem Scale); PMR: Progressive Muscle Relaxation; QBI-20: Questionnaire on Body Image; SASS: Social Activity Self-Assessment Scale; SCL-K-9: Symptom's Checklist; SCS: Social Contact Scale (Multidimensional Self-Esteem Scale); SPS: Sporting Self-Esteem Scale (Multidimensional Self-Esteem Scale); VBD: Vital Body Dynamic (Questionnaire on Body Image)

INTRODUCTION

Major Depressive Disorder (MDD) is a widespread problem for public health care systems in the world, with a lifetime prevalence rate between 15% and 20% [1-4]. Therefore, clinicians and researchers have become increasingly interested in therapeutic interventions, which go beyond established first-line psychotherapy and pharmacotherapy. One option is sport and exercise therapy [5,6]. Its effectiveness has been confirmed in several meta-analyses, which support the application of sport and exercise programs into clinical settings [7-10]. While the general effectiveness of sport and exercise therapy has been well documented, it is still unclear which kind of physical activity should be applied. Here aerobic exercise has been the favorite physical activity to be used in study protocols [11,12]. Apart from aerobic exercise, a combination of weight trainings, game sports, and body-and-mind oriented interventions (e.g., Qigong or Progressive Muscle Relaxation) is often used in clinical settings. Nevertheless, the scientific evidence for the effectiveness of such combined exercise interventions is rare [13,14]. In addition, there is still a lack of guidelines for sport and exercise therapies in the treatment of MDD, so that they are often based on intuition and best-practice models. Therefore, Weigelt and colleagues provided recommendations for sport and exercise therapy that transfer psychotherapeutic measures into exercise programs. Accordingly, combined sport and exercise therapy should:

- Promote the spontaneous initiation of actions and cognitive flexibility.
- Allow for mistakes and make them part of the learning process.
- Improve body awareness and the sensation of bodily states.
- Build up physical activity as a positive experience.
- Improve stress coping skills and self- efficacy.

Based on these recommendations, the present study compares the effects of single-handed aerobic exercise and a combined sport and exercise approach as part of a complex treatment program of MDD in a day clinic psychiatric setting. The rational for examining these two kinds of interventions was (1) That multi-modal exercise programs have a positive influence on the health and well-being (as signified by physical, functional, and quality of life variables) of older adults, and (2) That combined exercise interventions are already in use at day care clinics, while the empirical evidence for such practice is rare. Here we investigate, whether a combined sport and exercise intervention generates higher exercise treatment effects than aerobic exercise. Exercise treatment effects were assessed by a variety of questionnaires. The major hypothesis is, that a combined exercise program is more effective than single-handed aerobic exercise therapy with regard to depression severity (main outcome parameter). On an explorative level we assumed the combined exercise program to be more effective than single-handed aerobic exercise therapy with regard to overall psychopathological symptom severity, body image, social activity, cognitive complaints (secondary outcomes) [15-19].

MATERIALS AND METHODS

Procedure and participants

The study was performed in a day clinic, located in the city center. Patients were recruited between 01 June 2013 and 31 November 2014. After admission, clinical psychologists and psychiatrists consecutively screened the patients for eligibility. A total of n 6=62 participants fulfilled the inclusion criteria and were quasi-randomized to one of the two conditions, i.e. they

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were alternately assigned to condition A (combined exercise group) or condition B (aerobic exercise group). Considering a control group without any intervention was not possible due to ethical guidelines. Two patients refused to participate before randomization (Figure 1). Inclusion criteria were (i) Age 18 to 65 years, (ii) Admission into the day clinic because of a current depressive episode (ICD-10 F32 or F33), dysthymia (F34.1), mixed anxiety and depression (F41.2) or adjustment disorder with prolonged depressive reaction (F43.21), and (iii) Written informed consent. Patients are showing orthopedic, cardiovascular, and/or internal medicine problems or acute psychosis, that prohibited participating in a regular sport and exercise training, were excluded. Before the first training session (t1), participants completed the whole battery of questionnaires in a pre-test within about one hour. The post-treatment assessment (t2) took place when they left the clinic. The study was approved by the ethics committee of the University Munster (Date of approval: 15th October 2013) and registered at the German Register of Clinical Trials (DRK; registration number: DRKS00028254). Standards of good clinical practice and the demands of the Declaration of Helsinki were fulfilled.

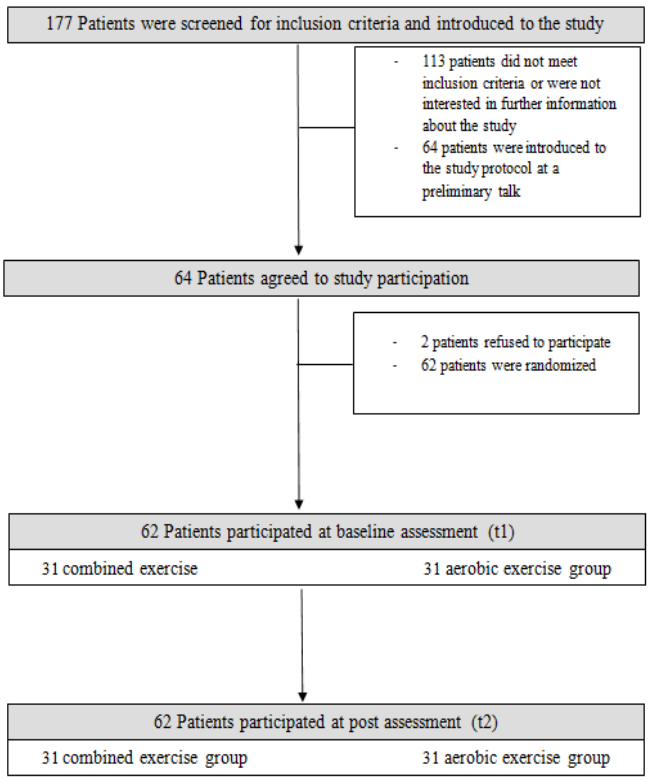

Figure 1: Study flowchart with patients from the combined exercise group and aerobic exercise group.

Intervention

Training in the combined exercise group consisted of a combined sport and exercise program including 60 minutes Nordic walking, 30 minutes progressive muscle relaxation, 45 minutes general exercise therapy, and 45 minutes Qi Gong (four sessions per week). Participants randomized to the aerobic exercise group completed three sessions of Nordic walking (each 60 minutes) per week. Each session started with a 10 minutes warm-up, followed by 45 minutes of Nordic walking, and a cool-down phase of 5 minutes. Both interventions were offered during the whole day-hospital stay for each participant (6 to 8 weeks). The mean attendance rate (combined exercise group: 4.3 ± 1.82, aerobic exercise group: 4.6 ± 2.0) of the sport and exercise therapy was not different between the two groups. The usual treatment regime consisted in both groups of extensive visits, pharmacotherapy if indicated, cognitive behavioral therapy, training of social competencies, occupational therapy, and weekly sessions with the primary nurse.

Psychological diagnostics

The following battery of questionnaires was used for psychological diagnostics:

- Beck Depression Inventory (BDI II) is a clinical, 21 items questionnaire, which can be used to evaluate the severity of depression.
- The Symptom's Checklist (SCL-K-9) was used to measure the global severity index on a four-point likert scale with 9 items.
- The Questionnaire on Body Image (QBI-20) provides information about two independent dimensions of the body image, each consisting of 10 items (Negative Body Image (NBI) and Vital Body Dynamic (VBD).
- The Social Activity Self-Assessment Scale (SASS) tests social functions and their impairments within 20 items, on a four-point likert scale.
- The Multidimensional Self-Esteem Scale (MSES) consists of 32 items to measure different scales of self-esteem. The two main scales are the general self-esteem scale (GSE) and Body Self-Esteem Scale (BSE).
- The questionnaire on the Subjective Evaluation of Mental Performance (Flei) is a mental performance test of attention, memory, and cognitive flexibility.

It consists of 35 items, on a four-point likert scale. Physiological diagnostics (activity sensors) During every session, the kcal consumption was measured as a physiological parameter by using activity sensors (accelerometer Move II, Movisens GmbH,Karlsruhe/Germany). Move II consists of a triaxial acceleration sensor with a range of ± 8 g, a 64 Hz sampling frequency, and a 12-bit resolution. The activity sensors were given to each participant before each session and were worn on the right side of the hip.

Statistical analysis

Potential differences of baseline characteristics between the two groups were analysed using t-tests and $\chi 2$ analysis. All treatment effects were analysed using the intent-to-treat principle [20,21]. All data were analyzed using SPSS 17. Data of the activity sensors were analyzed using the software "data analyzer", "sensor manager" and "unisens viewer". A series of Analyses of Variance (ANOVAs) with repeated measurements were used for the within-subject factor time (t1 vs t2), the between-subject factor (aerobic exercise training vs. combined sport and exercise training) as well as their interactions. T-tests were used for adjusted posthoc analyses (sequential procedure). Moreover, standardized effect sizes were calculated using Cohen`s d.

RESULTS

Characteristics of both groups are presented in Table 1. The statistical analysis (t/χ^2-test) showed no significant differences between the groups at baseline with regards to the personal data and the mean values of the measurement instruments (Table 2). With regard to the average kcal consumption, the consumption in the combined exercise group was 6.19 (± 2.1) kcal/kg/week and was 11.67 (± 2.7) kcal/kg/week in the aerobic exercise group, with the difference being statistically significant ($t(60)=-9.019$, $p<.001$). Pre and post-treatment scores of all questionnaires are presented in Table 2.

Table 1: Descriptive group characteristics.

Characteristic	Combined exercise group (n=31)	Aerobic exercise group (n=31)	t/χ^2	df	p
Age	M (SD)	M (SD)	0.6	60	0.551

	42.8 (11.89)		41.0 (11.52)				
Sex	N	%	N	%	1.13	1	0.288
♂	13	41.9	9	29			
♀	18	58.1	22	71			
Diagnosis	N	%	N	%	13.07	9	0.159
Depressive Disorder (F 32 and F 33)	30	96.7	29	93.5			
Dysthymia (F 34.1)	1	3.2	1	3.2			
Mixed anxiety and depressive disorder (F 41.2)	0	0	1	3.2			
Education	N	%	N	%	3.63	3	0.304
No graduation	1	3.2	0	0			
Lower secondary school	8	25.8	5	16.1			
Secondary school	7	22.6	13	41.9			
High school	15	48.4	13	41.9			
Duration of current episode	N	%	N	%	5.54	4	0.236
1-4 weeks	0	0	1	3.2			
1-3 months	4	12.9	8	25.8			
4-6 months	9	29	0	0			
7-12 months	9	29	12	38.7			
>12 months	9	29.9	10	32.2			
Transfer from inpatient stay	N	%	N	%	0.08	1	0.776
Yes	8	25.8	9	29			
No	23	74.2	22	71			
Number of previous psychiatric treatments	N	%	N	%	3.3	4	0.507
0	8	25.8	14	45.2			
1	13	41.9	10	32.2			
2-4	8	25.8	6	19.4			
5-7	1	3.2	1	3.2			
8 and more	1	3.2	0	0			
Hospital stay	N	%	N	%	0.56	4	968
1-2 weeks	2	6.5	1	3.2			
2–4 weeks	5	16.1	6	19.4			
4–6 weeks	7	22.6	8	25.8			
6–8 weeks	9	29	9	29			
> 8 weeks	8	25.8	7	22.6			
Current Pharmacotherapy	N	%	N	%	0.08	1	0.767

Yes	24	77.4	23	74.2			
No	7	22.6	8	25.8			
Regular sporting activity before admission	N	%	N	%	1.13	1	0.288
Yes	22	71	18	58.1			
No	9	29	13	41.9			
Frequency of previous sport acitivities per week	N	%	N	%	3.09	4	0.542
0	9	29	13	41.9			
1-2	9	29	5	16.1			
3-4	8	25.8	10	32.2			
5-6	3	9.7	1	3.2			
Every day	2	6.5	2	6.5			
Mean attendance of sport- and exercise therapy (weeks)	M (SD) 4.3 (1.82)		M (SD) 4.6 (2.00)	-0.61	60	0.545	
Kcal /week/kg during the program	M (SD) 6.19 (2.08)		M (SD) 11.67 (2.67)	-9.02	60	.000**	

Note: *p<.05 **, p<.01.

Table 2: Outcome measures before (t1) and after (t2) treatment; M (SD)

	Combined Exercise group M (SD)		**Aerobic Exercise group M (SD)**		**Main effect time" F, df (d)**	**Main Effect group" F, df (d)**	**Interaction „time" x „group" F, df (d)**
	t1	t2	t1	t2			
BDI II	27.4 (9.47)	22.6 (10.29)	25.8 (10.6)	18.1 (8.40)	51.91, 1** (1.86/0.46)	1.74, 1	2.84, 1
SCL-9-K	2.0 (0.81)	1.7 (0.88)	1.7 (0.71)	1.4 (0.75)	15.42, 1** (1.01/0.20)	2.18, 1	.011, 1
QBI-20-NBI	29.8 (10.04)	29.2 (10.17)	31.1 (10.98)	30 (11.26)	2.03, 1	.164, 1	.178, 1
QBI-20-VBD	24.1 (7.08)	23.8 (8.57)	26.1 (5.87)	28.5 (6.93)	2.76, 1	3.77, 1	(0.52/0.06)
SASS	33.2 (6.72)	34.1 (6.80)	33.0 (8.04)	35.6 (6.61)	8.28, 1* (0.74/0.12)	.144, 1	2.07. 1
MSES-GSE	85.4 (25.08)	91.4 (26.36)	82.6 (23.30)	95.4 (26.75)	23.82, 1** (1.26/0.28)	.007, 1	3.39, 1
MSES-BSE	35.4 (11.76)	38.4 (12.54)	34.2 (13.16)	39.2 (13.88)	18.10, 1** (1.10/0.23)	.003, 1	1.01, 1
Flei-A	22.3 (9.21)	21.4 (8.50)	21.4 (8.87)	20.1 (8.05)	8,60, 1	.001, 1	.720, 1
Flei-M	21.7 (8.83)	20.3 (8.35)	21.4 (9.42)	21.2 (8.66)	13,36, 1	14,44, 1	2,18, 1
Flei-E	20.7 (8.95)	18.7 (8.32)	20.0 (9.37)	18.6 (7.65)	13,10* (0.60/0.08)	144,2, 1	1,17, 1

Note: *p<.05, ** p<.01

Beck Depression Inventory (BDI): Decreasing scores from t1 to t2 indicate a lower level of self-reported depressive symptoms after the intervention in both groups. The within group effect sizes for the combined exercise group was d=0.49 and for the aerobic exercise group d=0.80. ANOVA indicated that the main effect of "time" was significant (F(1, 60)=51.91; p=.000), but not the "group" (F(1, 60)=1,74; p=.192) nor the interaction of "time x group" (F(1, 60)=2.84; p=.097).

Symptom's Checklist (SCL-K-9): Decreasing scores from t1 to t2 indicate a lower level of global severity after the intervention in both groups. The within group effect sizes for the combined exercise group was d=0.41 for the aerobic exercise group and d=0.35 for the combined exercise group. ANOVA indicated that the main effect of "time" was significant (F(1, 60)=15.42; p=.000), but not the "group" (F(1, 60)=2,18; p=.145) nor the interaction of "time x group" (F(1, 60)=.011; p=.918).

Questionnaire on Body Image (QBI): Decreasing scores from t1 to t2 indicate a lower level of negative body image (QBI-20-NBI) after the intervention in both groups. ANOVA indicated that the main effect of "time" was not significant (F(1, 60)=2.03; p=.160), nor the "group" (F(1, 60)=164; p=.687) nor the interaction of "time x group"(F(1, 60)=.178; p=. 675). Regarding the vital body dynamic (QBI-20-VBD) increasing scores from t1 to t2 indicate a higher level after the intervention in both groups. ANOVA indicated that the main effect of "time" was not significant (F(1, 60)=2.76; p=.102), nor the "group" (F(1, 60)=3,77; p=.057) but the interaction of "time x group" (F(1, 60)=4,03; p=.049), *i.e.* the factor "time" was mediated by the factor "group". A Post-hoc t-test for depended samples was significant between t1 and t2 for the aerobic exercise group (t(60)=-2,61; p=.014), but not for the combined exercise group (t(60)=244; p=.809). A post-hoc t-test of the mean value differences for the two groups between t1 and t2 was significant (t(60)=2,01, p=.049). Nevertheless, effects sizes were negligible for the combined exercise group (Cohen's d=-0.04) and small for the aerobic exercise group (Cohen's d=0.37).

Social Activity Self-Assessment Scale (SASS): Increasing scores from t1 to t2 indicate a higher level of social function after the intervention in both groups. The within group effect sizes for the combined exercise group was d=0.1 and for the aerobic exercise group d=0.35. ANOVA indicated that the main effect of "time" was significant (F(1, 60)=8.28; p=.006), but not the "group" (F(1, 60)=144; p=.705) nor the interaction of "time x group" (F(1, 60)=2.07; p =.155).

Multidimensional Self-Esteem Scale (MSES): Increasing scores from t1 to t2 indicate a higher level of general self-esteem after the intervention in both groups. The within group effect sizes for the combined exercise group was d=0.23 and for the aerobic exercise group d=0.51. ANOVA indicated that the main effect of "time" was significant (F(1, 60)=23.82; p=.000], but not the "group" (F(1, 60)=007; p=.936) nor the interaction of "time x group" (F(1, 60)=3,39; p=.070).

Regarding the body self-esteem scale, increasing scores from t1 to t2 indicate a higher level after the intervention in both groups. The within group effect sizes for the combined exercise group was d=0.25 and for the aerobic exercise group d=0.37. ANOVA indicated that the main effect of "time" was significant (F(1, 60)=18.10; p=.000), but not the "group" (F(1,60)=,003; p=. 955) nor the interaction of "time x group" (F(1, 60)=1.01; p=.317).

Subjective Evaluation of Mental Performance (Flei): Decreased scores from t1 to t1 on the Flei-A scale indicate a higher attention after the intervention in both groups. ANOVA indicated that the main effect of "time" was not significant (F(1, 60)=8,60; p=.135), as well as the "group" (F(1, 60)=001; p=.601) nor the interaction of "time x group" (F(1, 60)=,720; p=.749). Decreased scores from t1 to t1 on the Flei-M scale indicate a higher memory after the intervention in both groups. ANOVA indicated that the main effect of "time" was not significant (F(1, 60)=13,36; p=.193), as well as the "group" (F(1, 60)=14,44; p=.876) nor the interaction of "time x group" (F(1, 60)=2,18; p=.331). Decreased scores from t1 to t1 on the Flei-E scale indicate a higher executive function after the intervention in both groups. ANOVA indicated that the main effect of "time" was significant (F(1, 60)=13,10; p=.032), but not the the "group" (F(1, 60)=144,24; p=.826) nor the interaction of "time x group" (F(1, 60)=1,17; p=.764). Low effect sizes in both groups suggest that mental performance is only influenced marginally by the interventions.

DISCUSSION

The aim of the present intervention study was to compare the effectiveness of a combined sport and exercise program, which was conducted according to the recommendations for sport and exercise therapy of Weigelt and colleagues, with aerobic exercise training. The results of this study showed comparable treatment effects for the combined sport and exercise program and the aerobic exercise training program. In this regard, all participants, who received either combined exercise training or an aerobic exercise training, demonstrated significant improvements for nearly all measurement instruments over the course of the study. Especially, the depression BDI scores (main\outcome) improved significantly after the training program, for both groups. These results let us reject the main hypothesis that treatment effects are higher for the combined exercise group with regard to depression outcome. In addition, scores of the secondary outcome parameters decreased significantly after the treatment in both groups without any differences. Thus, the two different interventions affected the improvement to an (almost) similar extend. An interaction of the time-effect with group could only be observed for the vital body dynamic, indicating a higher benefit for the aerobic exercise group. Therefore, an aerobic exercise training might have a better effect on the energetic and movement-related aspects of the body image. The kcal consumption was significantly higher for the aerobic exercise group in comparison to the combined exercise group (6.19 ± 2.1 kcal/kg/week *vs.* 11.67 ± 2.7 kcal/kg/week). Hence, the positive effect on body image might be based on the high training intensity of the aerobic exercise group. In sum, these results also contradict the explorative hypotheses that treatment effects are higher for the combined exercise group with regard to the secondary outcomes and point out that aerobic exercise therapy causes a stronger exercise treatment effect for the vital body image. Importantly, these positive exercise treatment effects that might be based on the exercise interventions were found despite the short intervention period of 6-8 weeks and the mean attendance rate of 4 weeks, and highlight the importance of sport and exercise measures during shorter periods of hospital stays. Overall, these findings are consistent with several studies suggesting that exercise interventions are effective in the treatment of MDD and support the assumption, that a combined sport and exercise intervention can generate similar exercise treatment effects than aerobic exercise. Enhancing good clinical practice, these findings deliver important implications for sport and exercise therapy: If a low-intensity and combined sport and exercise intervention is equally effective as an aerobic endurance training, it might be suitable for patients, who have limitations in physical mobility, suffer from side effects of medication or a lack of motivation. In addition, a combined intervention program allows the integration of various elements from psychotherapy into sport and exercise therapy. This matches perfectly with a multi-professional perspective and a resource-oriented approach in a complex integrated outpatient care model. Therefore, we argue for the use of a combined sport and exercise intervention program that is embedded in a continuum of behavioral healthcare measures. In contrast, an aerobic exercise training might be suitable to improve body image. Even though, this presumes, that patients have no limitations in physical mobility and are able to reach a high training intensity. Nevertheless, effect sizes in the present study were small, compared to previous studies, which reported medium and high effect sizes. A factor responsible for the small effect sizes concerns the other therapeutic measures that provide additional therapeutic benefits and reduce differences between the intervention and aerobic exercise group (overall effect of interventions). A strength of the present study is the comparison of two different sport and exercise therapeutic measures in a homogeneous day clinic group, as well as the "real life conditions", instead of creating laboratory conditions. However, some limitations of the study should be mentioned as well: First, the sample size is rather small. In order to reveal significant effects of the questionnaires that show slight improvements, further studies with a large sample sizes should be supplied. Second, we had no wait-list control group, due to the advice of the ethic committee, it was not possible to realize a full randomization. Therefore, a randomized controlled trial is needed, to exclude this bias. Third, regarding the overall treatment effect, it is not possible to figure out the effect of a single therapeutic measure.

CONCLUSION

Further investigations should exclude therapeutic side effects by using ambulant treatment, for example. In sum, the present study shows that the effects of a combined sport and exercise program, based on the guidelines of Weigelt and colleagues do not differ from anaerobic exercise training. These findings indicate the positive use of sport and exercise programs in the treatment of MDD.

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