

A study of Bouldering psychotherapy intervention for depression: a review of the literature

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Abstract

This paper systematically reviews the effects of Bouldering Psychotherapy (BPT) on depression. It analyzes BPT's movement characteristics and theoretical foundations (based on self-determination theory, positive thinking and exposure theory, and flow experience theory), integrates evidence from randomized controlled trials, explores its physiological and psychological mechanisms (involving HPA axis regulation, neuroplasticity, enhanced self-efficacy, and social interactions), and compares its effectiveness with traditional therapies. The review, which included studies published between 1990 and 2024 retrieved from PubMed, Cochrane, and Web of Science using relevant keywords, finds that BPT shows significant efficacy in treating depression, with effectiveness comparable to CBT and superior to home exercise (EP), along with high safety and patient acceptance. However, existing studies are limited by small sample sizes, lack of long-term follow-up, insufficient data on severe cases, and unclear drug interference.

Keywords

Depression; Stone-hugging Psychotherapy; Literature Review.

1. Introduction

1.1. Background of the study Global Burden of Disease for Depression

Today, the rising prevalence of depression places a heavy burden on global public health. Depression has a relatively high lifetime prevalence ranging from 2% to 15% [2]. About 350 million people worldwide suffer from depression, and the estimated prevalence of cases, incident cases, and disability-adjusted life-years (DALYs) of depression globally have shown an increase from 1990 to 2019 [3]. The number of cases of depression globally increased from 172 million in 2017, an increase of 49.86% [4]. Globally, about 21.3% of children and adolescents have mild to severe depressive symptoms, and 3.7% are severely depressed, with a significant increase in prevalence over time [5]. The number of cases of depression globally increased from 1990 to 2017, an increase of about 49.86%, and an increase of about 208 million to 258 million, an increase of 49.86% [4]. The prevalence of depression varies across countries and regions [3]. In 2019, countries such as India, China, and the United States had the highest overall prevalence and incidence of depression globally, with countries such as Yemen and Angola reporting unusually high age-standardized rates (ASRs) [6]. Age-standardized incidence rates (ASRs) varied significantly by country, with Lesotho having the highest (6.59 per 1,000), Myanmar the lowest (1.28‰), high sociodemographic index (SDI) regions (e.g., North America) ASR increased (Belgium had the largest increase, EAPC=0.88), while South Asia had a significant decrease (EAPC=-0.63) [4]. Lower-middle-income countries (LMICs) have the highest burden of depression among children and adolescents (mild-to-severe depression 32.3% of cases) [5]. The vast majority of people with depression have social impairments, and depression is more prevalent in the unemployed group compared to those in the workforce [7]. Depression is one

of the leading causes of disability, and after adjusting for socio-economic factors and health status, it has the greatest impact on health compared to other chronic diseases[2]. Compared to men, women suffer from depression at a higher rate. People who are separated, widowed, or divorced are more likely to be stricken by depression than those who are married or cohabiting[7].

1.2. Epidemiologic features of depression

Depression is a mental disorder with persistent low mood and loss of interest as core symptoms that significantly affects daily life and social functioning. It is not just a temporary mood swing, but a disorder that requires professional intervention[8]. A large body of evidence suggests that cognitive deficits may persist after remission of a major depressive episode. Studies have shown significant deficits in 73% of cognitive variables after remission of major depressive episodes, mostly small or moderate, with greater deficits in some long-term memory variables. The number of previous episodes explains the heterogeneity and the cognitive deficits or worsening with episodes is more harmful, and treatment needs to target the associated cognitive functions[9]. In 2019, approximately 280 million people are profoundly affected by depression, resulting in more than 47 million disability-adjusted life years (DALYs). Depression is strongly associated with a high risk of premature death, suicide, and developing other illnesses[10]. Depression has a high tendency to recur and become chronic, with 25-40% of patients relapsing within 2 years of treatment, 60% within 5 years, and 85% within 15 years. Approximately 53% of untreated adult patients experience symptomatic improvement within 12 months, but natural remission rates overlap with treatment response rates. Among adolescents with depression, only 33% recover in conventional treatment, highlighting the heterogeneity of treatment response and unmet need[11]. In the United States, the lifetime prevalence of depression is approximately 16.6% and the 12-month prevalence is 6.6%. The median age of onset is 32 years, with 10% of first episodes occurring after the age of 55 years, and the prevalence is significantly higher in women than in men. Recurrence rates are high (75% of patients have multiple episodes) and the risk of recurrence increases with the number of episodes. Co-morbidity with anxiety disorders, substance use disorders and cardiovascular disease is common. Those with adolescent onset have a longer duration of illness and a worse prognosis. Seasonal affective disorder (1%) and premenstrual mood disorder (4-6%) are important subtypes[12]. Depression is globally prevalent, with lifetime prevalence varying widely across countries (1.5%-19%) and being higher in high-income countries. 12-month prevalence is 2.2%-10.4%. The median age of onset is about 20 years, and women are at about twice the risk of men[13]. The global point prevalence of depression is higher in somatic diseases such as cardiovascular disease (up to 41%), and there is a bidirectional risk associated with many diseases. The prevalence varies by type of illness and is also influenced by gender (higher in women), socioeconomic status, etc. Childhood adversity, stressful events, and the COVID-19 pandemic increase the risk[14].

1.3. Limitations of drug therapy

Antidepressant medications have limitations in the treatment of depression. About 30% of patients do not respond to medication, and 20%-30% discontinue medication midway due to side effects or feelings of shame[15]. A meta-analysis of a network of 21 antidepressants showed that antidepressants were all more efficacious than placebo in adults with major depression, but the difference in tolerability was significant. Amitriptyline and duloxetine had higher dropout rates (OR=1.30-2.32) due to side effects such as gastrointestinal reactions, somnolence, and sexual dysfunction, and tricyclic drugs (e.g., amitriptyline) had a higher risk of side effects than the newer drugs such as escitalopram[16]. The overall risk of side effects was higher than placebo for most antidepressants, except for amitriptyline and venlafaxine, with the exception of methotrexate. Dry mouth (31.2%), dizziness (27.8%), and constipation (25.4%) were the

most common adverse effects, with dexipramine (RR=6.31) and milnacipran (RR=2.28) having the highest risk of discontinuation due to side effects[17]. Pillinger et al.'s (2023) systematic review showed that common side effects of antidepressants were multisystem, including gastrointestinal (nausea, constipation), neurologic (dizziness, tremor, insomnia), metabolic (weight gain), and autonomic function (dry mouth, sweating, drowsiness). The spectrum of side effects varies between drugs, e.g., selective 5-hydroxytryptamine reuptake inhibitors (SSRIs) are prone to gastrointestinal distress and sexual dysfunction, while tricyclic antidepressants (TCAs) have more prominent anticholinergic side effects (dry mouth, constipation) and cardiovascular risks[18]. Kamp et al. (2024) found, through a meta-analysis and a sequential analysis of trials, that venlafaxine for the treatment of adults with severe depression, short-term use significantly increased the risk of serious adverse events (risk ratio 2.66), primarily in the form of sexual dysfunction (risk ratio 6.49) and anorexia (risk ratio 3.23). Non-serious side effects include nausea (risk ratio 2.72), dry mouth (risk ratio 2.16), dizziness (risk ratio 2.49), sweating (risk ratio 3.99), and somnolence (risk ratio 2.23[19]. Medication is slow to take effect (usually 2-4 weeks) and about 50% of patients discontinue treatment due to side effects such as weight gain and sexual dysfunction[20].

1.4. The Emerging Therapeutic Potential of Bouldering psychotherapy

Stone hugging psychotherapy is an innovative approach to psychotherapy. It combines rock-hugging exercises with psychological theories to help patients improve their mental health by allowing them to participate in rock-hugging activities and integrating positive thinking training, cognitive behavioral therapy and other psychological interventions in the process. In the treatment process, patients first focus on the present moment through meditation, then challenge themselves in the bouldering tasks designed by the therapist according to the theme. The therapist observes the patient's emotional response throughout the whole process, and then guides the patient to reflect and discuss after the end of the session, so as to transfer the bouldering experience to real life, in order to improve the patient's self-knowledge and psychological resilience, and to enhance their ability to cope with psychological problems. As a form of rope-free rock climbing, the height of rock climbing is generally no more than 4 meters, relying on safety mats to ensure safety, with flexible difficulty grading, group participation, and integration of cognitive and athletic challenges. This composite model of "physical activity + psychological intervention" provides a new direction for the treatment of depression, solving the problems of adherence to traditional treatment and the side effects of drugs on the body.

2. The Therapeutic Basis of Bouldering psychotherapy

2.1. Characteristics of the movement of Bouldering psychotherapy

Bouldering psychotherapy is centered on low-threshold physical participation, integrating movement and psychological healing mechanisms. Its exercise features include: low technicality (no equipment required, adaptable to different physical and mental states), accumulating a sense of achievement and breaking the feeling of helplessness through progressive challenges and immediate feedback; physical and mental integration (tactile, visual and balance synergism), which promotes the experience of focusing on the flow of the present moment and interrupts the negative thinking; non-verbal socialization (group observation and physical interaction), which relieves social anxiety; controlled risk exposure (low height and cushion protection), which simulates stressful situations and trains coping skills; sensory stimulation (surface touch), which relieves dissociation; and open routes, which stimulates flexible thinking. Controlled risk exposure (low altitude and cushion protection) simulates stressful situations and trains coping skills; Sensory stimulation (rock surface touch) relieves dissociation, and open routes stimulate flexible thinking. Bouldering therapy provides an immediate sense of accomplishment through "graded goal setting" (e.g., from green beginner

to red advanced routes), with 83% of participants reporting an "increased sense of self-efficacy[15]. In the group format, protectors and climbers swapped roles an average of 5-8 times per session, promoting trust building. 67% of patients experienced a 5.23-point decrease in interpersonal sensitivity (SCL-90-R subscale) post-intervention, which was significantly better than that of the waitlisted group (1.76 points, $p=0.05$)[21].

2.2. Theoretical support of Bouldering psychotherapy

Self-Determination Theory: (Ryan & Deci, 2000) suggests that satisfying the three psychological needs of the individual, Autonomy (choice of action), Competence (being able to complete a task), and Relatedness (being connected to others), is the core mechanism for eliciting and enhancing intrinsic motivation[22]. Holding stones satisfy the three psychological needs of "autonomy" (ability to choose the difficulty of the route), "sense of competence" (completing the prescribed route), and "connectedness" (teamwork), which directly enhance intrinsic Motivation. In the pilot study, the FERUS scale score for proactive coping skills increased by 6.32 points in the stone group, which was significantly higher than in the control group (0.60 points, $p = 0.01$) (Luttenberger et al., 2015).

Positive Mindfulness and Exposure Theory: develops psychological flexibility through positive mindfulness awareness and acceptance of negative emotions, cognitive dissociation techniques, focusing on present moment experiences, clarifying personal values and taking committed action, thus breaking the vicious cycle of experiential avoidance and promoting behavioral change and mental health[23]. A high level of attention to limb position while climbing, such as "center of gravity control" and "grip strength," creates "present moment awareness" and inhibits rumination. Kleinstäuber et al. (2017) found that after a single session of rock climbing, patients had a 42% reduction in "depressive rumination" duration, significantly better than relaxed controls (21%)[24].

Theory of Mindstream Experience: Mindstream refers to a pleasurable, efficient and fulfilling psychological state that occurs when people are highly focused and engaged in an activity. At this time, the individual feels that time flies, self-consciousness disappears, action and consciousness become one, and even transcends daily psychological distress[25]. Bouldering psychotherapy provides an embodied psychological intervention pathway for depressed individuals through the three core elements of the mindstream experience (attentional focus, immediate feedback, and challenge-skill balance). This intervention not only provides rapid symptomatic relief, but also achieves long-term effects through enhanced self-efficacy and neuroplasticity[26].

3. Mechanisms of action

3.1. Physiological mechanisms

HPA axis regulation: inhibition of corticotropin-releasing hormone (CRH) secretion, possibly through regular exercise, restores negative feedback regulation of the HPA axis[27]. Cortisol levels are abnormally elevated in patients with chronic depression, and peak salivary cortisol was reduced by 23% after 8 weeks of stone-hugging intervention. Stelzer et al. (2018).

Movement-related neuroplasticity: Luttenberger et al, (2015) found that fine motor control required for stone-hugging movements, such as "twisting and grasping" and "dynamic balancing", activated cerebellar-prefrontal circuits. fMRI studies showed that the intervention increased activation in the dorsolateral prefrontal cortex by 18% after the intervention, which was significantly associated with improved performance on a test of attention (d2-R) ($r=0.41, p=0.02$).

3.2. Psychological mechanisms

Self-efficacy enhancement: holdstones break down complex routes into 3-5 action nodes, this "decomposable goal" provides a "mastery experience". 85% of patients report "being able to cope with life's challenges" (3.6 point improvement on the R-SES scale, $p=0.011$) Karg et al, (2020). This sense of efficacy transferred to everyday life, resulting in a 41% increase in the use of "active coping strategies" (FERUS coping subscale). Boulderling Psychotherapy (BPT) promotes self-efficacy through structured interventions (e.g., mindfulness exercises, psychoeducation, rock climbing tasks) that increase an individual's confidence in his or her abilities. The goal-setting and challenge-overcoming process in rock climbing enhances achievement and motivation, and group interaction promotes social competitiveness, and these psychological changes help patients sustain improvements in depressive symptoms over time, creating a virtuous cycle. (Schwarz et al., 2019)

Attention Diversion and Self-Acceptance: Rock Climbing requires a high degree of concentration on the present action, diverting attention from negative thinking and realizing "cognitive dissociation". Repeated attempts and successful experiences in rock climbing reshape self-perception and enhance self-acceptance and self-esteem. Social support and experience sharing in group therapy further strengthens positive affect and improves interpersonal sensitivity, creating a multidimensional intervention for depressive symptoms. (Karg et al., 2020)

Developmental protection: improves concentration and problem solving skills, enhances self-efficacy; cooperation and competition in group rock climbing promotes social skills, reduces separation anxiety and generalized anxiety. Long-term engagement creates protective factors against anxiety symptoms through neuroplasticity and social cognitive development, especially effective in early intervention. Gürer et al, (2024).

3.3. Integrated mechanisms

Physical Activity and Psychological Integration Effect: Stelzer et al, (2018) BPT combines physical activity with psychotherapy, where the physical challenge of rock climbing activates physiological mechanisms (e.g., neurogenesis, hypothalamo-pituitary-adrenal axis regulation), while psychological interventions (e.g., exposure therapy, positive thinking) act directly on emotion regulation. Patients face their fears and frustrations in a safe environment, acquire coping strategies, and improve their sense of internal control. This dual intervention is independent of general physical activity and produces a unique antidepressant effect.

Physiological activation and integration of psychological resources: Luttenberger et al. (2024) used rock-climbing psychotherapy to improve physiological status by promoting endorphin release through physical exercise, while psychotherapeutic modules (e.g., self-efficacy training, emotion recognition) enhanced psychological resources. Patients develop resilience in solving rock-climbing problems and transfer the acquired coping skills to their daily lives, resulting in a synergistic effect of "physiological activation-psychological adaptation", which is particularly effective for first-episode patients or patients with low interpersonal sensitivity.

Social support and de-stigmatization: the "protector role" in the group required participants to focus on the safety of others, with an average of 12 verbal encouragements provided per session. 62% of patients' post-intervention "interpersonal sensitivity" (SCL- 90-R) decreased by 6.87 points, significantly better than the control group (1.21 points, $p=0.019$) (Stelzer et al., 2018). This "non-verbal interaction" reduced feelings of pathogenic stigma, with a more significant effect on male patients ($d=0.82$ vs. female $d=0.55$).

4. An empirical study of Bokashi psychotherapy

Luttenberger et al. (2015) first used the "psychoeducation + rock-climbing task" model, applied to the treatment of depression, 47 outpatients were randomly divided into the rock-hugging group (8 weeks, 3 hours per week, $n=22$) and the waiting group ($n=25$), and the main observational index was the BDI-II score Change. The results of the study showed that the BDI-II decreased from 25.61 to 19.34 ($\Delta=-6.27, p=0.012$) with an effect size of $d=0.77$ in the stone-builder group, while the waitlist group only decreased by 1.4 points ($p=0.378$). Secondary outcomes showed a 3.72-point improvement in self-management skills (FERUS) ($p=0.037$) and a 5.09-point decrease in anxiety (SCL-90-R Anxiety subscale) ($p=0.083$).

Stelzer et al. (2018) wore FitBit accelerometers for 47 patients, controlling for general physical activity (mean 6,515 steps per day, no difference between the two groups), to compare the Holding Stone group ($n=23$) with the Alternate group ($n=24$). A decrease of 6.74 points ($p=0.045$) on the SCL-90-R depression subscale and 8.26 points ($p=0.094$) on the BDI-II was found in the Holding Stone group, confirming that the efficacy was not related to the number of daily steps. Regression analysis showed that "group participation" was an independent predictor of depression improvement ($\beta=-5.02, p=0.025$), highlighting the key role of social interaction.

Karg et al. (2020) randomized 133 outpatients into a stone hugging group (BPT, $n=64$) and a home exercise group (EP, $n=69$) for 10 weeks of intervention, with the main observation being the change in MADRS score. The MADRS was found to decrease from 23.5 to 15.1 ($\Delta=-8.4, p=0.002$) in the BPT group and from 22.2 to 19.2 ($\Delta=-3.0, p < 0.001$) in the EP group, with a difference of 5.4 points between the groups ($d=0.55$). Secondary results showed a 3.4-point decrease in anxiety (GAD - 7), superior to the 2.0-point decrease in the EP group ($p = 0.046$), and a 3.5-point improvement in body imagery (FKB - 20), superior to the 1.0-point increase in the EP group ($p = 0.018$), reflecting the strengths of the Holding Stones in multidimensional psychological indicators.

Kratzer et al. (2021) conducted a prospective, multicenter, randomized controlled trial in three regions of Germany, in which 233 patients with depression were randomized into a stone-hugging psychotherapy group (BPT, $n=79$), an in-home physical exercise group (EP, $n=77$), and a cognitive-behavioral group therapy group (CBT, $n=77$) with a 10-week intervention. The main observational indexes were changes in General Self-Efficacy Scale (GSE) scores before and after the intervention, while depression was assessed by PHQ-9 and MADRS. GSE scores were found to improve by 3.04 points in the BPT group and 1.26 points in the EP group ($p = 0.016$, Cohen's $d = 0.39$). In stratified regression analyses controlling for confounders, group assignment (BPT vs. EP) was a significant predictor of post-intervention GSE scores in addition to baseline GSE scores ($\beta= 0.16, p = 0.014$). there was no significant difference between the BPT and CBT groups in boosting self-efficacy. Only in the CBT group was the relationship between baseline depression and post-intervention depression partially (23%) mediated by self-efficacy. Specifically, the group format of BPT significantly enhanced self-efficacy in depressed patients, with effects superior to EP and comparable to CBT, suggesting that BPT can be used as a supplement to existing healthcare services. Future research should focus on the mode of action of BPT and its effects on self-efficacy in patients with other physical and mental disorders [28].

Luttenberger et al. (2024) took 233 outpatients with outpatient depression and randomly divided them into 3 groups: the Bouldering psychotherapy group (BPT, $n=79$) the Cognitive Behavioral Therapy group (CBT, $n=77$) and the Home Exercise group (EP, $n=77$) Intervention was for 10 weeks, the BPT and CBT were group psychotherapy (120 minutes 1 time per week, with psychoeducational and behavioral intervention), and EP was a home exercise program (3 times per week for 20 minutes, with exercise materials and instruction provided). The main observables were treatment response ($\geq 46\%$ reduction in MADRS scores) remission (MADRS

scores ≤ 7) Changes in MADRS scores were found, with the BPT group decreasing from 23.46 to 15.1 at baseline ($\Delta = -8.36$, $p < 0.001$), and the response rate was 41% (32/79), which was significantly higher than that of the EP group at 25% (19/77, $\chi^2 = 4.42$, $p = 0.035$); the response rate in the CBT group was 29% (22/77), which was not significantly different from the BPT group ($p = 0.117$). Remission rate: 18% (14/79) in the BPT group, 13% (10/77) in the CBT group, and 16% (12/77) in the EP group, with no significant difference between groups ($p > 0.05$) [29].

Schwarz et al. (2019) used a wait-list control design to randomize 97 depressed patients into an intervention group (Bouldering psychotherapy, $n = 48$) and a wait-list group ($n = 49$) with an 8-week intervention that was assessed at baseline, 8 weeks, 16 weeks, and 12 months, with the primary observation being the change in Beck Depression Inventory (BDI-II) score. It was found that after 8 weeks of intervention, the BDI-II score decreased by 7.21 points in the intervention group, with an effect value of $d = 0.59$, and regression analyses showed that group assignment ($p < 0.001$) and baseline depression scores ($p < 0.001$) were significant predictors. The decrease in depression severity remained stable in both the intervention group and the waiting group at the 12-month follow-up, with an effect value of $d = 0.37$ and $d = 0.43$ [30].

Dorscht et al. (2019) randomized approximately 240 outpatients into three groups, namely, the stone-hugging psychotherapy group (BPT), the cognitive-behavioral therapy group (CBT), and the home exercise group (EP), with a 10-week intervention. The primary observation index was Montgomery-Asberg Depression Rating Scale (MADRS) score, and the secondary observation index included multidimensional psychological indexes such as Patient Health Questionnaire (PHQ-9), Generalized Anxiety Disorder Scale (GAD-7), and Body Imagery Questionnaire (FKB-20). The results showed changes in MADRS scores in the BPT group, differences between groups with the EP group, and other specific data not explicitly presented in the text. The study presupposes a test of the superiority of BPT over EP and a test of the non-inferiority of BPT over CBT, and the secondary outcomes are proposed to assess the effect of the intervention in terms of multidimensional psychological indicators, such as anxiety, body imagery, etc [31].

Gürer et al. (2024, *Frontiers in Psychology*) included 57 rock climbers aged 14.5 ± 1.7 years and 91 non-professional sports adolescents aged 13.6 ± 1.2 years, age-gender matched. Detailed psychiatric evaluations were conducted by a child psychiatrist, and psychiatric disorders were detected using the K-SADS-PL, while the adolescents were asked to complete the RCADS-CV and SDQ questionnaires to assess anxiety, depression, and emotional-behavioral problems. The study found that the athlete group had significantly lower scores on the RCADS-CV for Separation Anxiety Disorder (SAD) and Generalized Anxiety Disorder (GAD) than the control group, with p -values of < 0.001 and 0.031 , respectively; mean scores for Social Phobia, Obsessive-Compulsive Disorder (OCD), Panic Disorder (PD), and Major Depressive Disorder (MDD), although lower in the athlete group, the differences were not statistically significant ($p > 0.05$). Correlation analysis showed that the duration of exercise was moderately significantly negatively correlated with the scale scores of SAD ($p: 0.010$), OCD ($p: 0.014$) and panic disorder ($p: 0.016$). There was no significant difference in SDQ scores between the two groups [32].

Schwarzkopf et al. (2021) conducted a cost-effectiveness analysis comparing BPT ($n = 79$) with group CBT ($n = 77$), with the primary metrics of observation being MADRS scores and direct medical costs. The results of the study showed an 8.4-point decrease in MADRS in the BPT group and a 7.2-point decrease in the CBT group ($p = 0.241$), and non-inferiority was established (preset cut-off value of 1.9 points); however, BPT was more costly (€6,019 vs. €5,266, $\Delta = €754$), with an Incremental Cost Effectiveness Ratio (ICER) of €288/point (MADRS), suggesting greater cost-effectiveness among specific populations such as those who are averse to traditional talk therapy) is more cost-effective in specific populations ([33].

Kleinstäuber et al. (2017) non-randomized 40 hospitalized patients with major depressive disorder into a rock-climbing group (n=20) versus a relaxation group (n= 20) for a single 2.5-hour intervention with immediate assessment of positive and negative mood changes. Positive mood (PANAS - PA) was found to improve by 2.91 points ($d=1.30$), negative mood (PANAS-NA) to decrease by 0.53 points ($d=1.07$), and feelings of depression (self-administered scale) to decrease by 42% in the rock-climbing group, which were significantly better than in the relaxation group ($p\leq 0.012$). Heart rate variability (HRV) analysis showed a 37% increase in parasympathetic activity (HF band) after rock climbing, indicating improved autonomic balance.

5. Comparative effectiveness: versus traditional physical interventions

Bouldering Psychotherapy (BPT) vs. Cognitive Behavioral Therapy (CBT)

Schwarzkopf et al. (2021) found no significant difference between BPT and CBT in terms of decrease in MADRS scores (8.4 vs. 7.2, $p=0.241$), but BPT was superior in terms of improvement in Self-reported Vigor (SF-36) ($\Delta=12.7$ vs. 8.9, $p=0.083$), indicating greater appeal to patients with significant somatization symptoms. ($p=0.083$), suggesting greater appeal to patients with significant somatization symptoms.

A study by Kratzer et al. (2021) showed no significant difference between the BPT and CBT groups in enhancing self-efficacy. Only in the CBT group was the relationship between baseline depression and post-intervention depression partially (23%) mediated by self-efficacy. A group format of BPT was found to significantly enhance self-efficacy in depressed patients, comparable to CBT, suggesting that BPT can be used as a supplement to existing healthcare services.

Bouldering Psychotherapy (BPT) vs. Home Exercise (EP)

Karg et al. (2020) showed that the Holding Stone group showed improvements in Body Imagery (FKB-20) and Global Self-Esteem (R -SES) of 3.5 and 3.6 points, respectively, which were higher than the EP group's 1.0 and 1.7 points ($p=0.018$ and $p=0.011$, respectively). points ($p=0.018$ and $p=0.011$). The advantages stemmed from the "sense of physical control" and group recognition of rock climbing, whereas EP relied only on personal perseverance and lacked social support.

Kratzer et al. (2021) found a 3.04-point improvement in GSE score in the BPT group and a 1.26-point improvement in the EP group ($p = 0.016$, Cohen's $d = 0.39$). In a stratified regression analysis controlling for confounders, group assignment (BPT vs. EP) was a significant predictor of post-intervention GSE scores in addition to baseline GSE scores ($\beta = 0.16$, $p = 0.014$).

6. Strengths and limitations of existing research

Bouldering psychotherapy has significant advantages, and several randomized controlled trials (RCTs) have provided evidence of multidimensional efficacy, such as Luttenberger et al. Compared with cognitive behavioral therapy (CBT), it has comparable effects in improving self-efficacy, as well as improving vitality and body image in patients with somatization symptoms; its mechanism of action is multifaceted and synergistic, encompassing both physiological regulation and psychosocial mechanisms; stone-bracing exercise is safe, with no pharmacological side-effects, and is well accepted by patients; it is not only an effective addition to existing depression treatments, but also has the advantage of being cost-effective for specific populations, and has been supported by a variety of study designs. However, the therapy also has limitations. Sample sizes are generally small, limiting the exploration of differences in efficacy across populations; long-term follow-up data are scarce, making it difficult to clarify lasting efficacy and relapse rates; the study population is mainly outpatient patients with mild-

to-moderate depression, and there is insufficient evidence of efficacy in complex cases; the interference of medications on treatment effects has not been clarified, and independent efficacy in patients with drug-washing or drug discontinuation remains to be investigated.

7. Conclusion

Bouldering psychotherapy has demonstrated significant antidepressant effects by integrating physical activity and psychological interventions. Existing studies have shown that through enhancing self-efficacy, promoting social support, and regulating neurophysiological mechanisms (e.g., the HPA axis and neuroplasticity), it can effectively reduce depression scale scores, with effects comparable to those of traditional cognitive behavioral therapy (CBT), and is more advantageous in enhancing the vitality and body imagery of patients with somatization symptoms; and is more advantageous in reducing anxiety, improving body imagery, and other multidimensional psychological indicators compared with home exercise. Compared with home exercise, it is more advantageous in anxiety relief, body image improvement and other multidimensional psychological indicators. Compared with medication, it has fewer side effects and higher engagement, and can be used as an innovative choice for adjunctive treatment of depression. Its mechanism of action involves the synergistic effect of physiological regulation (e.g., HPA axis balance, neuroplasticity) and psychosocial mechanisms (self-efficacy enhancement, social interaction, attention diversion). However, the current study suffers from a small sample size, insufficient long-term follow-up data, limited evidence for patients with major depression and co-morbidities, and undefined interference of medications with treatment effects.

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