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Original Article

Exploring the Effect of Psychological Interventions on Anxiety and Depression in Adolescents based on Behavior Change Wheel Theory

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Abstract

Background: Anxiety is a common mental health problem among adolescents that substantially increases the risk of anxiety disorder. Depression in adulthood and is a high-risk factor leading to suicide. We aimed to explore effective anxiety intervention methods in view of the annual rising detection rate of anxiety in adolescents.

Methods: We enrolled 150 volunteers with mild anxiety or above (anxiety scale≥50 points) from 1015 adolescents between March and May 2023 in four communities in Shenyang, Liaoning Province and Nantong, Jiangsu Province in China. The participants were randomly divided into the experimental and control groups, comprising 73 and 74, respectively. The experimental group was given 2-month psychological intervention based on behavior change wheel (BCW) theory, whereas the control group was given no intervention.

Results: The average anxiety score of the participants was 46.57 ± 14.19, with 40.4% having anxiety symptoms. Anxiety was statistically correlated with self-evaluation of physical condition, family relationship, and grades ($P < 0.05$). The depression and anxiety score of the experimental group was significantly lower than that of the control group ($P < 0.001$).

Conclusion: Anxiety has become a common phenomenon among adolescents. Self-evaluation of physical condition, family relationship, and grades are the focus of intervention for individuals with anxiety. The intervention method proposed in this study can effectively reduce the level of anxiety and depression in adolescents, providing a new perspective for formulating anxiety intervention strategies for adolescents.

Keywords: Behavior change wheel; Anxiety; Depression; Adolescents

Introduction

Anxiety is one of the common psychological problems occurring in adolescence. According to an epidemiological report by the WHO, anxiety disorder is found in 301 million individuals worldwide, including 58 million children and adolescents, with a rising incidence rate and more frequent incidence among younger people (1). The lifetime prevalence of severe anxiety disorder among the 13–18 year old population in the United States is 11.0%. Overall, female adolescents have higher prevalence and severity of anxiety disorder than male adolescents, and elder

adolescents have higher prevalence and severity of anxiety disorder than younger adolescents (2). According to the "Report on National Mental Health Development in China (2022)" issued by the Chinese Academy of Sciences, an investigation on the mental health of nearly 80,000 college students found that the detection rates of depression and anxiety risks are approximately 21.48% and 45.28%, respectively (3). Anxiety attack not only affects adolescents' academic performance, damages their social roles, increases the risk of dropping out of school, and exacerbates their anxiety and physical illnesses, but also leads to problematic behaviors such as alcohol and drug dependence, self-harm, and violent attacks (4). Additionally, it is the primary factor leading to suicide among adolescents (5). Anxiety during adolescence increases the risk of anxiety disorder and depression during adulthood. The latter highlights the necessity of early detection and prevention of anxiety in adolescents.

Anxiety, as a psychological disorder, is closely related to one's thoughts and emotions, for which the use of psychotherapies is a necessary means of treatment (6). In addition, most psychological interventions have no side effects and are recommended by many psychological counselors. At present, common clinical psychotherapies include cognitive-behavioral therapy, interpersonal psychotherapy, mindfulness therapy, psychodynamic therapy, positive psychotherapy, rational emotion therapy, acceptance and commitment therapy, Morita therapy, and emotion-focused therapy (7-9). A functional imaging study on the psychotherapy mechanisms for anxiety disorder showed that the top–down regulation of subcortical regions by higher-order cortical regions is enhanced after successful psychotherapy and that this macroscopic systematic approach provides valuable insights (10). From the literature review, despite several researchers exploring the effect of different psychological interventions in reducing anxiety in adolescents, most of them applied a single intervention method, focused on changes in individual indicators, and paid less attention to changes in objective factors such as environment and education. Consequently, they overlooked the sustainability of the intervention effect. The development of anxiety is affected by a number of factors, including personal factors, environmental factors, community support, and so on (11). However, current studies are scarcely formulating intervention measures and analyzing the intervention effects from a theoretical perspective.

Behavior Change Wheel (BCW) Theory is a tool developed by Michie et al. through a systematic review based on 19 behavior change-related frameworks and theories related to guide the design or evaluation of behavior change intervention schemes (12). This theory encourages intervention workers to consider all intervention options and select the most effective option through systematic evaluation, thus maximizing the use of existing understanding and resources for the development of intervention schemes (13). Therefore, it has promising application prospects in behavior change interventions. Psychological interventions based on BCW refers to the process of systematically and step by step exerting influence on the psychological activities, personality traits, or behavioral problems of a certain object under the guidance of the Theory of BCW, combined with psychological theory, in order to make it change towards the expected goal. This intervention is primarily applied in the fields of public health and medicine and has obtained excellent results. Its functions include 1) improving patients' compliance, such as enhancing medication compliance and reducing pain in cancer patients by constructing a BCW health education model (14); 2) improving the compliance and quality of life of patients with bronchial asthma using inhalation therapy (15). BCW was also found to have an intervention effect in relieving negative mindsets, such as relieving the negative emotion of AIDS patients (16) and the pressure experienced by liver cancer caregivers (17).

In summary, BCW is currently applicable to promoting behavior change in healthy and sub-healthy populations throughout their entire life cycle, covering health management for children, healthy adults, and pregnant women. Currently,

however, no study focuses on the application of BCW in treating anxiety and depression in adolescents. The efficacy of BCW-based psychotherapy for the adolescent population needs evaluation.

This study was conducted to optimize the theoretical model of BCW and construct a new intervention scheme according to adolescents' psychological characteristics, aiming to test its effectiveness in reducing depression and anxiety in adolescents, explore a treatment method suitable for adolescents with anxiety, and provide reference for better promoting adolescents' mental health.

Materials and Methods

A preliminary survey was conducted using convenience sampling between March and May 2023 in four communities in Shenyang, Liaoning Province and Nantong, Jiangsu Province in China. Inclusion criteria were as follows: 1) adolescents in their 1st and 2nd year at university; 2) adolescents without any other organic or mental illnesses; and 3) adolescents who voluntarily participated in the survey. 1,053 copies of the questionnaire filled out. After the exclusion of invalid copies such as those failing attention tests, those answered too quickly, and those with incomplete answers, 1,015 valid copies were finally obtained with an effective response rate of 96.4%. With reference to the classification criteria of commonly used psychological assessment scales, those volunteers with anxiety ≥50 (mild anxiety or above) were randomly grouped. 150 participants were included and randomly divided into two, with 75 members each in the experimental and control groups. Finally, 147 participants completed the follow-up intervention (73 and 74 in the experimental and control groups, respectively). No statistically significant differences existed in the demographic characteristics between the two groups ($P > 0.05$), indicating their comparability as shown in Table 1.

This study was approved by the Ethics Committee of Shenyang Jianzhu University (Number: 2023-001)

Research tools

Demographic characteristic variable questionnaire

This questionnaire was designed by the researchers based on the literature review, covering gender, age, family residence, whether the only child, whether from a single-parent family, degree of family harmony, grades, number of close friends, and physical condition, among others.

Self-rating Depression Scale (SDS) (18)

SDS is used to screen for depressive symptoms with 20 items (including 10 reverse questions), each scored by 1–4 points. The standard score is calculated by multiplying the total score by 1.25. According to the Chinese norm, the critical value of the standard score is 53, with 53–62 indicating mild depression, 63–72 indicating moderate depression, and above 72 indicating severe depression. The Cronbach's α values of SDS measured before and after intervention in this study are 0.82 and 0.87, respectively (20).

Self-rating Anxiety Scale (SAS) (19)

SAS has 20 items, and its cutoff value was determined by distribution in a large-sample population. The normal upper limit for the total score of Chinese normal individuals is 40. In this study, according to the severity classification criteria (psychological testing software) currently used in general hospitals, the standard score <50 indicate no anxiety; ≥50 indicate mild anxiety; >60 indicate moderate anxiety; >70 points indicate severe anxiety. The Cronbach's α values of SAS measured before and after intervention in this study are 0.85 and 0.83, respectively (20).

Intervention method

The participants were grouped by the non-enrolled workers responsible for randomization in the center using the random allocation table. Blind implementation: The experimental and

control groups were determined using the random allocation table. The control group was given routine in-school mental health education, while the BCW experimental group was given positive psychotherapy based on BCW apart from mental health education.

Intervention scheme: Based on literature review and previous research results, 9 intervention functions including education, persuasion, motivation, coercion, training, restriction, environmental reconstruction, modeling, and implementation were apprised using BCW as the foundation. A scheme was formulated according to the needs of adolescents with anxiety, thereby facilitating the implementation of targeted intervention to change their motivation, improve their abilities, and increase opportunities. The specific intervention steps are as follows. 1) Forming motivation: understanding adolescents' cognition and views based on the analysis of the influencing factors of anxiety in combination with their lifestyles, habits, anxiety, and other psychological factors; 2) Setting goals, strengthening motivation, and applying strategies, including education, training, and persuasion: distributing a health education manual, explaining the causes, clinical manifestations, triggering factors, and related risk factors of anxiety, and helping the participants analyze their own unhealthy behavioral habits, correct incorrect cognition, and build a positive mindset of hope; 3) Teaching the participants to engage in independent psychological management, including controlling negative emotions; 4) Strengthening abilities and motivation and implementing educational and restrictive strategies. Regular interviews with the participants were conducted to encourage and assist them in developing personalized self-management plans, including expanding social interaction, increasing physical exercise, and establishing a positive mindset. This intervention lasted for two months. Anxiety and depression scales were filled out before and after intervention to examine the effectiveness of the intervention.

Statistical methods

SPSS 22.0 statistical software (IBM Corp., Armonk, NY, USA) was used for statistical analysis. Mean and standard deviation ($x \pm s$) were used to statistically describe the quantitative data; frequency and ratio were used to statistically describe the qualitative data. T-test and analysis of variance were used to conduct univariate analysis on the variables and anxiety; multiple linear regression (stepwise method with the inclusion and exclusion criteria being 0.05) was used to screen for the influencing factors of anxiety; paired t-test was used for comparison before and after intervention; chi square test was used for comparison between binary classification data groups; Wilcoxon rank sum test was used for comparison between ordered classification data groups. $P < 0.05$ was considered to indicate statistically significant differences.

Results

Comparison of anxiety scores among participants

Respondents comprised 525 boys (51.7%) and 490 girls (48.3%), with an average age of 20.9 ± 0.9 years old. The standard score in anxiety is 46.57 ± 14.19 points. 410 participants were found to have anxiety symptoms, accounting for 40.4%. Among them, 246 participants have mild anxiety (50–60 points), accounting for 24.2%; 130 have moderate anxiety (61–70 points), accounting for 12.8%; 34 have severe anxiety (≥ 70 points), accounting for 3.3%. Table 1 shows their specific scores. As seen in Table 1, anxiety is not statistically correlated with gender, the only child, single-parent family, family residence, and family economic condition but is statistically correlated with self-evaluation of physical condition, family relationship, and grades ($P < 0.05$).

Table 1: Comparison of anxiety scores among participants

Demographic data		*N*	*Scores*	t /F	*P*
Gender	Male	525	46.39±14.25	0.429	0.668
	Female	490	46.77±14.14		
Self-evaluation of physical condition	Very good	173	43.82±13.57	5.02	0.001
	Good	240	45.46±13.98		
	General	261	46.45±13.74		
	Bad	238	48.00±13.98		
	Very bad	103	50.84±16.08		
Family relationship	Very good	279	45.66±14.28	2.576	0.036
	Good	302	45.67±13.90		
	General	214	46.54±14.33		
	Bad	139	48.16±14.24		
	Very bad	81	50.48±13.92		
The only child	Yes	491	46.59±13.97	0.035	0.972
	No	524	46.56±14.40		
Single-parent family	Yes	64	48.91±18.64	1.347	0.178
	No	950	46.44±13.83		
Grade	Freshman	509	47.77±14.92	2.694	0.007
	Sophomore	506	45.38±13.32		
Family residence	Rural	499	46.64±13.88	0.150	0.880
	Town	516	46.51±14.49		
family economic condition	Very rich	142	41.04±12.70	1.169	0.323
	Rich	240	45.46±13.98		
	General	261	46.45±13.74		
	Poor	269	48.99±13.81		
	Very poor	103	50.84±16.08		

Comparison of demographic data between the experimental and control groups

Overall, 150 participants with anxiety scale≥50 points (mild anxiety or above) from totally 1015 valid respondents were included in the study and randomly divided into the experimental and control groups with 75 members in each group. Finally, 147 participants completed the follow-up intervention (73 and 74 in the experimental and control groups, respectively). As shown in Table 2, no statistically significant differences existed between the two groups in age, gender, self-evaluation of physical condition, family relationship, the only child, single-parent family, grades, family residence, and family economic situation ($P > 0.05$), indicating that they are comparable (Table 2).

Comparison of anxiety scores between the experimental and control groups before and after the intervention

As shown in Table 3, no statistically significant difference was seen regarding anxiety between the two groups before intervention (t = 0.690, $P = 0.491$). After 2-month intervention, both groups had lower anxiety scores, and the differences were statistically significant than the scores before intervention ($P < 0.001$). The comparison of scores between the two groups after intervention showed that the anxiety score of the experimental group was lower than that of the control group after intervention, and the decrease in the experimental group's anxiety was greater than that of the control group with statistical significances ($P < 0.01$). This finding indicates that the experimental group had received better efficacy than the control group.

Table 2: Comparison of demographic data between the experimental and control groups

Demographic data		***Control group (n=74)***	***Experimental group (n=73)***	**Statistical value**	***P***
Age(yr)		20.26±0.83	20.36±0.90	t=0.695	0.488
Gender	Male	37	35	χ^2=0.062	0.803
	Female	37	38		
Self-evaluation of physical condition	Very good	8	8	Z=0.128	0.898
	Good	18	19		
	General	20	18		
	Bad	21	22		
	Very bad	7	6		
Family relationship	Very good	7	5	Z=1.116	0.264
	Good	12	8		
	General	16	15		
	Bad	20	23		
	Very bad	19	22		
The only child	Yes	36	36	χ^2=0.369	0.543
	No	38	37		
Single-parent family	Yes	66	67	χ^2=0.286	0.593
	No	8	6		
Grade	1st year	39	32	χ^2=1.157	0.282
	2nd year	35	41		
Family residence	Rural	35	39	χ^2=0.552	0.458
	Town	39	34		
family economic condition	Very rich	17	16	Z=0.239	0.811
	Rich	17	22		
	General	22	17		
	Poor	12	11		
	Very poor	6	7		

Table 3: Comparison of anxiety scores before and after intervention

Group	***Before intervention***	***After intervention***	***Difference before and after intervention***	***Comparison of P-values within the group***
Experimental group (n=73)	59.89±8.07	53.61±9.56	6.28±5.7	<0.001
Control group (n=74)	60.75±7.02	58.08±7.86	2.67±3.46	<0.001
t	0.690	3.098	4.641	
P	0.491	0.002	<0.001	

Comparison of depression scores between the experimental and control groups before and after intervention

As shown in Table 4, no statistically significant difference in depression was seen between the two groups before intervention (t = 1.302, P = 0.195). After 2-month intervention, both groups have lower depression scores, and the differences were statistically significant than the scores before intervention (P < 0.001). The comparison of scores between the two groups after intervention showed that the depression score of the experimental group was lower than that of the control group after intervention, and the decrease in the experimental group's depression was greater than that of the control group with statistical significances (P < 0.01).

Table 4: Comparison of depression scores before and after intervention

Group	*Before intervention*	*After intervention*	*Difference before and after intervention*	*Comparison of P-values within the group*
Experimental group (n=73)	54.81±8.58	45.51±9.84	9.30±8.59	<0.001
Control group (n=74)	56.68±8.87	53.73±11.7	2.96±6.93	<0.001
t	1.302	4.608	4.910	
P	0.195	<0.001	<0.001	

Discussions

The standard score of adolescents in anxiety in this study was 46.57 ± 14.19 points, basically similar to the results of the systematic review of anxiety among Chinese university students by Li (20) and higher than the average anxiety score of adolescents in Chongqing, China (21), which may be linked with the use of different scales. In this study, participants with anxiety account for 40.4% of the total survey sample, indicating that anxiety had become a common phenomenon among adolescents, and measures should be taken to reduce the occurrence of anxiety in adolescents. As shown in Table 1, anxiety is statistical correlated with self-evaluation of physical condition, family relationship, and grades (P < 0.05). The research results show that gender and the only child are not related to anxiety, which is consistent with previous survey results (22). However, some studies found that adolescents study different majors during their college years and different personalities, which are related to the occurrence of anxiety. For example, Liu found that medical college students have lower anxiety scores than those studying non-medical majors (23). Introverted adolescents are not accustomed to seeking help from others when facing setbacks, whereas those with poor physical condition are overly concerned of their own health. Consequently, adolescents with introverted personalities and poor physical condition are more prone to anxiety. In addition, a statistically significant relationship exists between degree of family harmony and anxiety. College students with lower degrees of family harmony are more likely to experience anxiety, revealing the importance of family relationship to adolescents' mental health.

These results suggest that the occurrence of anxiety in adolescents can be prevented and controlled from the following two aspects: First, family members should establish a favorable family atmosphere, communicate and exchange frequently with each other, and increase family support. Second, adolescents should establish a health-friendly and positive lifestyle, actively participate in physical exercise, and promote their physical fitness and stress resistance. Meanwhile, adolescents should learn to confide in their good

friends, recognize personal strengths, and build confidence. When encountering difficulties, they are advised to promptly inform their family members and friends and seek help.

The results of this study further confirm the efficacy of positive group psychological intervention based on BCW in reducing anxiety and depression symptoms in adolescents for the following reasons: first, a large number of evidence-based studies have confirmed that positive psychological theory has a significant effect in alleviating and treating depression and anxiety in adolescents. The results of this study show that positive group psychological counseling can reduce anxiety and depression, which is basically consistent with previous research results. Previous studies have found that positive psychological intervention can reduce the level of depression in HIV carriers or AIDS patients in the homosexual population (24). Positive group psychological intervention can significantly improve the learning adaptation of 1st-year college students and reduce exam anxiety in college students (25). Second, hopelessness and lack of motivation are typical symptoms of depression (26). The intervention model proposed in this study can help individuals with anxiety clarify intervention goals, rebuild confidence, and determine ways to cope with their current difficulties, thereby significantly reducing anxiety symptoms in adolescents.

From Tables 3 and 4, both groups have lower anxiety scores after 2-month intervention, with statistically significant differences than the scores before intervention. Under the guidance of BCW, intervention workers can strengthen their psychological interaction and cooperation with individuals with anxiety through intervention measures such as setting goals, developing plans, and solving specific problems to increase their trust and satisfaction. Higher utilization of support by patients could promote their motivation for help-seeking (27). Psychological medical support is an important link in the management of patients with mental illnesses, but psychological counselors often overlook their intrinsic motivation for behavioral changes, focus on unidirectional knowledge transfer, and neglect patients' individualized needs (28). This finding also suggests that in the psychological management of patients with mental disorders, workers should set targeted intervention goals according to their specific needs, provide them with relevant information and emotional support, encourage them to actively participate in decision-making, and thus promote positive psychological management. This finding means that psychological intervention and psychotherapy should focus on enhancing people's spontaneous and reflective motivation. The results of this study show that self-management attitude can motivate patients to establish and maintain health-friendly behaviors, improve self-psychological instruction, and establish positive psychological resources. Therefore, BCW is conducive to enhancing patients' self-management attitude, thereby improving their disease control and quality of life.

The intervention model proposed in this study can stimulate motivation in patients, encourage them to actively participate in the formulation of intervention schemes, improve their psychological support by enhancing psychological disease prevention, promote them to establish health-friendly behaviors, and correct their previous misconceptions regarding psychological problems and possible avoidance behaviors, thereby allowing individuals with anxiety to form health-friendly behaviors while improving prognostic rehabilitation.

This study has the following limitation: the participants were limited to adolescents from four communities in China. In future research, the sample size should be expanded to ensure the accuracy and objectivity in evaluating the intervention effect.

Conclusion

After investigating totally 1015 valid respondents, this study found that 40.4% of the adolescents involved have symptoms of anxiety, indicating severe anxiety in adolescents. Self-evaluation of physical condition and family relationship are the main influencing factors of anxiety in adoles-

cents. Positive group psychotherapy based on BCW was used to intervene in anxiety and depression in adolescents. Positive psychological intervention based on BCW can significantly reduce anxiety and depression in adolescents. It is an effective intervention method for alleviating psychological problems in adolescents.

Journalism Ethics considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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