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Can Coloring Pre-Structured Designs That Have Complexity Aid in Reducing Anxiety in Those Greater Than 17 Years of Age?

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A SELECTIVE EVIDENCE BASED MEDICINE REVIEW

In partial Fulfillment of the Requirements For

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In

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Department of Physician Assistant Studies
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ABSTRACT

Objective: The objective of this selective evidence based medicine (EBM) review is to determine whether or not coloring mandalas or designs that have complexity and structure can aid in reducing anxiety in those greater than 17 years of age.

Study Design: Review of three English language randomized controlled trials (RCTs), published in 2007, 2012, and 2015.

Data Sources: Three randomized controlled trials published in peer-reviewed journals obtained using PubMed and EBSCOhost.

Outcomes Measured: The Curry and Kasser² study and the van dV and Serice⁷ study both used the State Anxiety Inventory (SAI) to record anxiety. The Henderson et al³ study used the State Trait Anxiety Inventory (STAI) to record anxiety.

Results: The studies by Curry and Kasser² and van dV and Serice⁷ found a statistically significant decrease in anxiety levels following 20 minutes of structured coloring, compared to free-form coloring. The study conducted by Henderson et al³ found that there was no statistically significant difference in anxiety reduction between those that participated in freehand mandala-coloring and those that participated in freehand coloring of specific objects.

Conclusions: The results showed that structured coloring is effective for reducing anxiety. Additional research should include a larger, more diverse population sample, as well as focus on specific designs and their complexity to determine which produce the largest anxiolytic effects.

Key Words: Mandalas, Anxiety, Art therapy, Drawing

INTRODUCTION

Anxiety is a common, normal emotion. Anxiety is defined as a subjective sense of fear, nervousness, worry, apprehension, or panic.^{5,6} Typically anxiety also produces physical symptoms, such as, palpitations, sweating, shortness of breath, chest pain, dizziness, muscular tension, and fatigue.^{1,5} Anxiety is a useful mechanism that the body employs during high stress situations, but for many individuals it may become disabling. When anxiety is left unchecked it may become pronounced and persistent, leading to impairment in daily activities. Once there is a disruption in the individual's daily functioning, it is considered an anxiety disorder.⁶ There are many types of anxiety disorders, such as generalized anxiety disorder (GAD), panic disorder, agoraphobia, phobic disorders, obsessive compulsive disorder (OCD), and post-traumatic stress disorder (PTSD). This paper evaluates three randomized controlled trials (RCTs) comparing the efficacy of coloring mandalas or designs that have complexity and structure, to free form coloring for reducing anxiety in those greater than 17 years of age.

Anxiety is the most prevalent psychiatric illness in the general population, transcending even depressive disorders.^{5,6} In the United States, approximately 25% of the general population will experience an anxiety disorder during some point in their life.⁶ Due to such a high prevalence, anxiety disorders pose a large financial burden on the health care system. The direct and indirect annual costs associated with anxiety disorders are estimated to be over \$50 billion per year.⁶ There is no data to illustrate the exact number of medical visits that result from anxiety, most likely because patients suffering from anxiety typically present with somatic complaints, rather than direct psychological complaints of feeling worried or anxious. In addition, these somatic complaints such as chest pain or fatigue for example, usually require extensive work-ups, only adding to the financial burden that anxiety disorders impose. It is estimated that only 15% to 36% of anxiety disorders are properly diagnosed in primary care.⁴

Currently, definitive pathophysiologic mechanisms have not been identified, however, it is believed that the development of anxiety disorders involves a multitude of factors, including biological irregularities, past and present stressors, maladaptive cognitions, and conditioned behaviors.⁶ Furthermore, central nervous system (CNS) related abnormalities are believed to be associated with neurotransmitters such as norepinephrine, serotonin, and gamma-aminobutyric acid (GABA).⁶ Research indicates that an “under-activation of the serotonergic system” and an “over-activation of the noradrenergic system” play crucial roles, as does the dysregulation of the GABA system.⁶ The role of these neurotransmitters is important, as current pharmacological treatment aims at restoring the balance between these key players. It is also believed that corticosteroid regulation may play a role, however, this relationship remains unclear.⁶ Lastly it is important to comment that physical symptomatology is largely attributed to activity generated by the autonomic nervous system, namely activity mediated by the sympathetic nervous system.

The treatment of anxiety depends on the specific disorder, as well as the severity, but includes a multifaceted approach including non-pharmacological and pharmacological therapies. Non-pharmacological treatments are considered first line therapy and include therapeutic counseling, cognitive behavioral therapy (CBT), and relaxation techniques.^{5,6} When symptoms are severe enough to significantly interfere with functioning, and when the proposed benefits of the medication outweigh the associated risks, pharmacological therapy is initiated.⁶ Medications generally used as monotherapy or combination therapy include; Selective Serotonin Reuptake Inhibitors (SSRIS) (e.g., Fluoxetine, Fluvoxamine, Paroxetine, or Sertraline), Serotonin Norepinephrine Reuptake Inhibitors (SNRIs) (e.g., Venlafaxine or Duloxetine), benzodiazepines (e.g., Lorazepam, Oxazepam, or Alprazolam), and Buspirone.^{5,6}

The treatment options mentioned above all play a valuable role in treating anxiety, however, as with all medications, there are associated risks, and each treatment option will have varying effects on each patient. While non-pharmacological treatment alone is not appropriate for all patients, it should be considered first line therapy and initiated as dual therapy even when medications are indicated, as well as for patients who fail pharmacological therapy. Structured coloring therapy, a form of non-pharmacological therapy, may be used as a safe and effective treatment option in treating anxiety. In recent years, mainstream media has highlighted the use of “adult coloring books.” The majority of the designs in these books are mandalas (i.e., any art form, namely geometric shapes, that are executed within a circular context³) or designs that mimic mandalas. It is believed that coloring, especially coloring structured designs with complexity (e.g., mandalas) has therapeutic effects similar to meditation that allows the individual to dampen intrusive thoughts and bring about a sense of mindfulness.^{2,3,7} Thus, coloring mandalas or designs with complexity and structure should aid in reducing anxiety.

OBJECTIVE:

The objective of this selective EBM review is to determine whether or not coloring mandalas or designs that have complexity and structure can aid in reducing anxiety in those greater than 17 years of age.

METHODS:

The studies selected in this evidence based medicine (EBM) review included three randomized controlled trials (RTCs), which were based on specific criteria. The population studied included both males and females, greater than 17 years of age, with anxiety. Although different methods were used in each study, the intervention of interest was structured coloring. The comparison group of interest was unstructured or free-form coloring. In the studies conducted by Curry and Kasser², and van dV and Serice⁷, participants went through an anxiety

induction procedure for 4 minutes, where they were asked to think and then write about a time they “felt most fearful.”² The participants were then randomly assigned to one of three conditions, the mandala group, plaid group, or free-form group, where they were asked to color for 20 minutes.² Both the mandala design and the plaid design consisted of 324 areas of various shapes, whereas the free-form design was a blank sheet of paper.² Comparisons were made between the experimental groups, in which participants received either a mandala or a plaid form, and control groups, in which participants received a blank piece of paper. The outcome measured was a reduction in anxiety after participating in structured coloring using then State Anxiety Inventory (SAI), a subjective questionnaire.

In the study conducted by Henderson et al³, qualified participants that showed “at least moderate levels of PTSD symptom severity” (i.e., greater than 10 on the Posttraumatic Stress Scale) were randomly assigned to one of two conditions, where for 20 minutes a day, for three days, they were instructed to color. Comparisons were made between the experimental group, where they were asked to color a mandala freehand, and the control group, where they were asked to color a different object freehand each day (i.e., cup, bottle, or pen). The outcome measured was a reduction in anxiety after participating in the mandala coloring intervention, using the State Trait Anxiety Inventory (STAI), a subjective questionnaire.

The studies collected for this selective EBM review were found via PubMed and EBSCOhost, using the key words “mandalas”, “anxiety”, “art therapy”, and “drawing.” All articles were written in English and published in peer-reviewed journals. The articles were researched and subsequently chosen based on their relevance to the clinical question, as well as importance to human subjects. The articles were meticulously chosen to ensure that they addressed patient oriented evidence that matters (POEM), in this case anxiety, and were within

the Physician Assistant scope of practice. Inclusion criteria consisted of articles that were RCTs published no later than 2002, which used structured coloring as an intervention for anxiety reduction. Exclusion criteria included participants under the age of 18, studies focused on disease oriented outcomes (DOE), and studies published after 2002. The summary of statistics reported in the studies included p-values, ANOVA, follow-up t- tests, paired sample t-tests, and ANCOVA. Patient demographics corresponding to each study are reported in Table 1.

Table 1 – Demographics & Characteristics of included studies

Study	Type	# Pts	Age	Inclusion Criteria	Exclusion Criteria	W/D	Interventions
Curry ² (2015)	RCT	84	18 - 22 years	Students 18 years old and older in an undergraduate psychology class	Participants under 18 years old	0	Color a mandala or plaid form for 20 minutes
Henderson ³ (2007)	RCT	36	18 - 23 years	One or more traumatic stressor(s), determined by the Posttraumatic Stress Disorder Scale (PDS) AND At least moderate levels of PTSD symptom severity (i.e., greater than 10 on the PDS)	Participants under 18 years old Participants currently in psychotherapy Participants currently taking psychotropic medication	0	Color a mandala for 20 minutes
van DV ⁷ (2012)	RCT	50	21 - 59 years	Students 18 years old and older in an undergraduate psychology class	Participants under 18 years old	0	Color a mandala or plaid form for 20 minutes

OUTCOMES MEASURED:

The outcomes measured in each of the studies focused on anxiety levels. The studies by Curry and Kasser² and van dV and Serice⁷ measured anxiety levels prior to anxiety induction, prior to the coloring intervention, and following the coloring intervention. Anxiety levels were measured using the SAI, which is a 20 item self-report, where the participants rated their current level of anxiety on a 9-point scale, ranging from “not at all” to “extremely”.^{2,7} The study by Henderson et al³ measured anxiety levels at baseline, after the third coloring session, and then at the one-month follow-up. Anxiety levels were measured using the STAI, which is a 40 item self-report, where the participants rated their current level of anxiety on a 10-point scale, ranging

from “not at all” to “very much so”.³ Both the SAI and STAI scores range from 20-80, with greater anxiety levels corresponding to higher scores.^{2,3,7}

RESULTS:

The three RCTs evaluated in this selective EBM review evaluated the efficacy of structured coloring on anxiety levels in adults over 17 years old. All studies provided continuous data that could not be converted to dichotomous data, therefore, the analysis of risk reduction (RRR), absolute risk reduction (ARR), and numbers needed to treat (NNT) could not be calculated. In addition, all three studies had a 0% attrition rate. No adverse effects related to the interventions were reported. Test statistics reported in Curry and Kasser’s² and van dV and Serice’s⁷ studies included p-values, change in mean from baseline, ANOVA, follow-up t- tests and paired sample t-tests. Test statistics reported in Henderson et al’s³ study included p-values and ANCOVA.

In the study conducted by Curry and Kasser², 84 participants underwent an anxiety induction procedure for 4 minutes. Following this, the participants were randomly assigned to either the mandala group ($n = 30$), the plaid group ($n = 27$), or the free-form group ($n = 27$), and asked to color for 20 minutes.² The participant’s anxiety levels were recorded using the SAI prior to the anxiety induction procedure (T1 anxiety scores), prior to the structured coloring intervention (T2 anxiety scores), and following the color intervention (T3 anxiety scores).² The corresponding mean scores, standard deviations, and p-values are summarized in Table 2. One-way analyses of variance (ANOVAs), were used to evaluate the effects of coloring on anxiety by comparing the anxiety levels of the three groups at T1, T2, and T3, and the changes in anxiety levels from T2 to T3.^{2,7} Paired *t*-tests were used to compare the changes in anxiety levels between the three different groups at T1 and T2, T2 and T3, and T1 and T3.^{2,7} An ANOVA conducted on the T3 anxiety scores revealed a significant difference between the three groups (p

< .001).² Follow-up *t*-tests were conducted to examine the difference in anxiety between each individual group.² The *t*-tests revealed that the mandala group and the plaid group had significantly lower T3 anxiety scores than did the free-form group ($p < .001$ respectively).² The mandala and plaid groups did not significantly differ from each other ($p = .32$).² To test the change in anxiety levels from post anxiety induction to post coloring intervention, T2 anxiety scores were subtracted from T3 anxiety and an ANOVA was run. Again an overall decrease in anxiety from T2 to T3 was found among the three groups ($p = .006$). Follow up *t*-tests were then conducted to investigate the differences in change in anxiety (T3 - T 2) between each group.^{2,7} The *t*-tests revealed that the mandala group showed a significantly larger decrease in anxiety than did the free-form ($p = .003$), as did the plaid group ($p = .03$).² Again, there was no difference found between the mandala and the plaid groups ($p = .46$).² Lastly, in order to determine treatment effect, a paired sample *t*-test comparing baseline anxiety (T1) and final anxiety (T3) was done, and revealed that the mandala group had a significantly lower T3 score compared to T1 ($p = .006$).² The plaid group did not have a significantly different anxiety level at T3 compared to T1 ($p = .09$).² Thus, the results of this study showed that compared to the baseline, the mandala and plaid groups had a notably greater reduction in anxiety compared to that of the free-form control group.

Table 2 –Differences between SAI Scores at T1, T2, and T3, and Changes from T2 to T3²

Variables	Mandala (n = 30)	Plaid (n = 27)	Free-Form (n = 27)	Total (n = 84)	P-value
T1 Score	39.97 (16.47)	41.52 (14.06)	41.11 (16.71)	40.83 (15.64)	$p = .93$
T2 Score	49.17 (20.10)	49.26 (18.74)	55.15 (22.62)	51.12 (20.47)	$p = .47$
T3 Score	32.07 (11.66)	35.78 (16.06)	55.07 (20.51)	40.65 (19.03)	$p < .001$
T3 – T2 Scores*	-17.10 (18.19)	-13.48 (18.78)	0.07 (23.60)	-10.46 (21.32)	$p = .006$

* negative scores indicated decreased anxiety scores after coloring

The study conducted by van dV and Serice⁷, was a replication study of Curry and Kasser’s² study. The experiment was conducted in the same manner as explained above, but with 50 participants, randomly assigned to either the mandala group ($n = 13$), the plaid group ($n = 15$),

or the free-form group ($n = 22$).⁷ An ANOVA of T3 anxiety scores revealed no significant difference between the three groups ($p = .20$).⁷ To test the change in anxiety from post anxiety induction to post coloring intervention, T2 anxiety scores were subtracted from T3 anxiety and an ANOVA was run. The ANOVA revealed a significant difference among the three groups ($p = .04$).⁷ The follow-up t -tests revealed that the mandala group had significantly lower T3 anxiety scores than did the free-form group ($p = .05$) or the plaid group ($p = .02$).⁷ Thus, the effects of free-form coloring on anxiety were not statistically different from the effects of coloring a plaid design.⁷ Lastly, in order to determine treatment effect, a paired sample t -test comparing baseline anxiety (T1) and final anxiety (T3) was used, and revealed that the mandala group had a significantly lower anxiety level at T3 than at T1 ($p = .03$). The plaid group did not have a significantly lower anxiety level at T3 compared to T1 ($p = .06$), however, it was nearing significance.⁷ The free-form group also did not have a significantly lower anxiety level at T3 compared to T1 ($p = .49$).⁷ Thus, the results of this study suggest that compared to the baseline, the mandala group had a notably greater reduction in anxiety compared to the plaid group or the free-form control group. The results suggest that while structured coloring may be the superior coloring method for reducing anxiety, not all structured coloring designs have the same anxiolytic effects. Table 3 summarizes the results.

Table 3 – Differences between SAI Scores at T1, T2, and T3, and Changes from T2 to T3⁷

Variables	Mandala ($n = 13$)	Plaid ($n = 15$)	Free-Form ($n = 22$)	Total ($n = 50$)	P-value
T1 Score	34.54 (11.07)	29.60 (8.20)	32.32 (8.83)	32.15 (9.37)	$p = .19$
T2 Score	44.38 (16.96)	40.27 (11.26)	39.32 (11.14)	41.32 (13.12)	$p = .26$
T3 Score	29.46 (9.10)	34.60 (13.23)	30.95 (9.16)	31.66 (10.51)	$p = .20$
T3 – T2 Scores*	-14.92 (11.14)	-5.67 (11.02)	-8.36 (10.94)	-9.65 (11.03)	$p = .04$

* negative scores indicated decreased anxiety scores after coloring

In the study conducted by Henderson et al³, 36 participants were randomly assigned to either the experimental (mandala) group ($n = 19$) or the control (specific shape) group ($n = 17$),

and for three consecutive days, the participants were asked to draw for 20 minutes.³ In addition to measuring anxiety levels using the STAI, this study also measured PTSD symptom severity, depressive symptomatology, independent spiritual meaning, and the frequency of physical symptoms, however, the results from these measures are omitted for the purpose of this selective EBM review. The participant’s anxiety levels were recorded prior to the coloring intervention (STAI1), immediately following the last coloring session (STAI2), and at the 1-month follow-up (STAI3).³ Since the two groups had differing baseline levels of anxiety at STAI1, a series of one-way analyses of covariance (ANCOVA) comparing the experimental and control groups were conducted, which allowed the researchers to calculate differences between treatment groups at STAI2 and STAI3.³ The researchers concluded that there was no statistically significant difference in anxiety reduction immediately following the coloring intervention between the experimental group (41.16) and the control group (44.05).³ In addition, there was also no statistically significant difference in anxiety reduction between the mandala coloring exercise (40.95) and the control group (42.0) at the 1-month follow-up.³ There was no change from baseline or other statistical analysis calculated to examine the difference in anxiety levels between each individual group, as only between-group comparisons were made. It can be noted that there was a decrease in mean scores in both the mandala and control groups from STAI1 to STAI2, as well as from STAI1 to STAI3, indicating that anxiety levels did decrease, however as aforementioned no further statistical analysis were conducted. Hence, the results of this study suggest that free-hand mandala coloring does not produce a greater reduction in anxiety levels than does free-hand coloring of specific objects. Table 4 summarizes the results.

Table 4 – Differences between STAI Scores at STAI1, STAI2, and STAI3³

Variables	Mandala (n = 19)	Control (n = 15)	P-value
STAI1	45.05 (10.75)	49.05 (12.29)	<i>p</i> = .282
STAI2	41.16 (11.30)	44.05 (10.12)	<i>p</i> = .622
STAI3	40.95 (11.54)	42.0 (13.26)	<i>p</i> = .533

DISCUSSION:

After careful review of the three RCTs discussed in this selective EMB review, the first two studies conducted by Curry and Kasser's² and van dV and Serice⁷ showed a statistically significant decrease in anxiety levels following a structured coloring intervention. The third study conducted by Henderson et al³ deserves special mention, as it was different from the first two in the respect that both the experimental group and the control group were coloring freehand. The evidence from this study was key, in that although it did not have an experimental arm illustrating structured coloring, it did reveal that freehand mandala-coloring did not have a statistically significant reduction in anxiety compared to freehand coloring of specific objects.³ This is important, because the first two studies revealed that coloring pre-drawn mandalas did cause a statistically significant reduction in anxiety levels, compared to free-form coloring.^{2,7} Thus, these results in combination with the results from the previous studies indicate that it is not specifically the mandala design in itself that leads to a reduction in anxiety levels, but rather the complexity and experience of coloring a pre-structured design that leads to anxiolytic effects. This is further supported by the evidence in Curry and Kasser's² study that revealed no statistically significant difference between anxiety reduction in the mandala group versus the plaid group.²

It must be noted that there are several limitations to the studies. One limitation is that the sample sizes studied, 84, 50, and 34, are quite small and thus can distort the validity of the results. Another limitation is that all three of the studies used a convenience sample that consisted of undergraduate psychology students. The lack of diversity, narrow age range (i.e., majority of the participants were 18 to 23 years old), and higher education level of the participants, makes for a participate population that is not exceedingly generalizable to the population as a whole. In addition, the results from the three studies are hard to compare due to

the lack of a standardized method of measuring anxiety levels, as well as the lack of standardized test statistics used to report the results of the interventions. Furthermore, the methods used to record anxiety levels in all three studies were self-reported questionnaires which are subject to response biases.

Overall, structured coloring is an inexpensive and uncomplicated way of reducing anxiety. In addition, it requires a small amount of time (e.g., 20 minutes) and has no contraindications, associated risks, or potential adverse effects.

CONCLUSION:

This selective EBM review of three RCTs indicates that coloring mandalas or designs that have complexity and structure can aid in reducing anxiety in those greater than 17 years of age. The first two studies revealed a statistically significant decrease in anxiety levels in those participants that participated in structured coloring, especially in those that colored mandalas. The third study revealed no statistically significant difference in anxiety reduction between those that participated in freehand mandala-coloring and those that participated in freehand coloring of specific objects. Future research should work to include a larger sample size so that these results may be more generalizable to the population as a whole. In addition, his study was limited to adults (i.e., over 17 years old), so future studies should aim to look at the use of structured coloring in younger adults and pediatric patients with anxiety, especially since other treatment options are usually limited in this population. Future research should analyze long-term effects of daily structured coloring on anxiety levels. Also, future research should be conducted on patients with known anxiety disorders to determine whether certain diagnoses respond better to structured coloring than others. Furthermore, future studies should focus on specific designs and their complexity to determine which have the largest anxiolytic effects when coloring.

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