

Effects of light music played by piano intervention on satisfaction, anxiety, and pain in patients undergoing colonoscopy

A randomized controlled trial

Dong-Jie Sun, MM^{a,b,c,d}, Yi-Xiang You, MM^b, Xiao-Jian He, PhD^{b,c,d}, Hai-Tao Li, PhD^{b,c,d}, Xiang-Peng Zeng, PhD^{b,c,d}, Da-Zhou Li, PhD^{b,c,d}, Wen Wang, PhD^{b,c,d,*} 

Abstract

Background: Colonoscopy is the main kind of way to detect and treat diseases about large intestine, but during the examination and preparation, these 2 processes are able to lead abdominal pain, abdominal distention and other discomfort feel, which will cause patients to refuse the examination and become anxious. Painless and sedative endoscopy may reduce discomfort of patients, but there is a risk of adverse effects. Many studies have shown that playing music during colonoscopy can reduce discomfort and increase acceptance of colonoscopy, but the conclusion remains controversial. The 3 approaches of random, single-blind, controlled method were used to investigate the interventions effects of piano light music on satisfaction, anxiety and pain in patients undergoing colonoscopy.

Methods: A total of 216 patients were randomly divided into piano music group (n = 112, piano music played during colonoscopy) and control group (n = 104, no music during colonoscopy) to compare patients satisfaction, anxiety score, pain score, vital signs, endoscopic difficulty score, and willingness to undergo colonoscopy again.

Results: There were no significant differences in vital signs, pre-colonoscopy state anxiety score, and trait anxiety score before and after colonoscopy, and willingness to undergo colonoscopy again between the 2 groups ($P > .05$). The difficulty of colonoscopy operation and the score of state anxiety after colonoscopy in the piano group were lower than those in the control group ($P < .05$), and the satisfaction of colonoscopy process, pain management and overall service satisfaction were better than those of the control group ($P < .05$), and they were more likely to listen to music in the next examination ($P < .001$).

Conclusion: The light music played by piano can relieve patients' anxiety, improve the satisfaction of colonoscopy process, pain management and service satisfaction, reduce the difficulty of colonoscopy, which have no obvious adverse reactions. Therefore, it is worthy of promotion.

Abbreviation: STAI = State-Trait Anxiety Inventory.

Keywords: anxiety, colonoscopy, music, pain, personal satisfaction

1. Introduction

Colonoscopy is the gold standard for the diagnosis and treatment of colorectal diseases, and it is also the main detection method for precancerous lesions and early cancerous of colorectal diseases.^[1] However, patients' unfamiliar conditions,

lack of understanding of the examination process, uncertainty of the examination results, worries about the recovery process, abdominal distension, spasm, pain and other discomforts during colonoscopy all make them anxious or even afraid of colonoscopy, which leads them to refuse the examination.^[2-4] In addition, anxiety and pain may lead to increase difficulty of

D-JS, Y-XY, X-JH, and H-TL contributed equally to this work.

This study was supported by the National Natural Science Foundation of China (grant no. 82100687), Foreign Cooperation Project of Fujian Province (grant no. 2019J0026), Science and Technology Project of Fujian Province (grant nos. 2018Y9116 and 2020J05283), the Managed Project of Fujian University of Traditional Chinese Medicine (grant no. XB2021186), and Hospital Program of 900TH Hospital (grant no. 2021MS20).

The authors have no conflicts of interest to disclose.

The datasets generated during and/or analyzed during the current study are not publicly available, but are available from the corresponding author on reasonable request.

^a Department of Digestive Diseases, Fuzong Teaching Hospital of Fujian University of Traditional Chinese Medicine, Fuzhou, China, ^b Department of Digestive Diseases, Fuzong Clinical Medical College of Fujian Medical University, Fuzhou, China, ^c Department of Digestive Diseases, 900th Hospital of PLA, Fuzhou, China, ^d Department of Digestive Diseases, Oriental Hospital Affiliated to Xiamen University, Fuzhou, China.

* Correspondence: Wen Wang, Department of Digestive Diseases, The Fuzong Clinical Medical College, Fujian Medical University, 156 North Road of West No.2 Ring, Fuzhou 350025, China (e-mails: wangwen1386@163.com).

Copyright © 2022 the Author(s). Published by Wolters Kluwer Health, Inc. This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial License 4.0 (CCBY-NC), where it is permissible to download, share, remix, transform, and buildup the work provided it is properly cited. The work cannot be used commercially without permission from the journal.

How to cite this article: Sun D-J, You Y-X, He X-J, Li H-T, Zeng X-P, Li D-Z, Wang W. Effects of light music played by piano intervention on satisfaction, anxiety, and pain in patients undergoing colonoscopy: A randomized controlled trial. *Medicine* 2022;101:52(e32339).

Received: 4 November 2022 / Received in final form: 21 November 2022 / Accepted: 29 November 2022

<http://dx.doi.org/10.1097/MD.0000000000032339>

colonoscopy or even inability to complete colonoscopy, and reduce patients satisfaction,^[5,6] which leads to adverse physiological manifestations such as changes in blood pressure and heart rate. It is found that most patients have some level of anxiety before colonoscopy.^[2,7,8] In recent years, painless and sedative endoscopy has greatly reduced the suffering of patients.^[9] However, due to the increase in labor costs and the need for appropriate anesthesia equipment, many centers are unable to provide anesthesia and sedation services to every patient. At the same time, anxiety and pain may increase the demand for sedation and anesthesia doses, potentially increasing the likelihood of adverse drug reactions.^[10,11] Previous studies have shown that music can attract the attention of patients and reduce physical and psychological discomfort feel, thereby reducing or even eliminating negative emotions in patients^[12] and improving patients' acceptance and satisfaction with colonoscopy.^[10,13,14] Due to its economic benefits, acceptability, noninvasive and no significant side effects,^[15] it has gradually become the focus of clinical researchers,^[16–18] and is widely used in various aspects of clinical practice, such as surgical patients,^[19] critically ill patients,^[19] cancer patients,^[20] and childbirth.^[21] However, the results of the study remain controversial^[22,23] and most studies do not provide specific and complete information on the music intervention, such as type of music, volume, duration, and instruments played. Previous studies have suggested that the presence of lyrics can make patients focus and increase alertness.^[24] Light music has the advantages of simple structure, brisk rhythm, beautiful melody, etc., which can make people relax, and it is a widely accepted type of music. Piano music has the characteristics of comfort, relaxation and sweetness, which is conducive to making people relax. The combination of the two may have a good effect. Therefore, this study selected piano music without lyrics in light music, and used a randomized, single-blind, and controlled method to explore the effect of light music intervention with noise-reducing headphones on satisfaction, anxiety and pain in colonoscopy patients. This study aims to provide better services to patients with colonoscopy and improve patients satisfaction with colonoscopy.

2. Materials and Methods

2.1. Patients and sample size

For the pilot randomized controlled trial, Hertzog^[25] recommended that 30 to 40 participants per intervention or control group will be needed to obtain a direct estimate of a between-groups effect size for a subsequent power analysis. Therefore, we set the minimum sample size for this study is 80.^[17] From October 2021 to April 2022, 240 patients who underwent electronic colonoscopy due to symptoms or physical examination were screened in the 900th Hospital of PLA, and 24 patients could not participate in the study for various reasons, and 216 cases were finally enrolled. The inclusion criteria were patients with electronic colonoscopy, stable hemodynamics and barrier-free communication. We excluded participants with a history of visual impairment, hearing impairment, cognitive impairment, and psychiatric impairment, because they had difficulty understanding the contents of questionnaire correctly. All participants were provided written informed consent.

2.2. Ethics approval and consent to participate

This study was approved by the Ethics Committee of 900TH Hospital of PLA and registered in the registry of China Clinical Trial Registry (no. ChiCTR2100051336). All methods of this study were performed following the Declaration of Helsinki. Written informed consent was obtained from all participating patients.

2.3. Establishment of a music library

We randomly selected 100 popular piano pieces with soft melody, moderate rhythm and no lyrics, and randomly selected 15 pieces from them to form a music library.

2.4. Research process

The researcher provided each patient with 4 opaque envelopes, half of which contained notes with the piano music group and the other half with notes written on the control group. Envelopes were randomly selected by patients prior to colonoscopy, opened and read by researcher, and divided into groups on this basis. Patients and endoscopists were not informed of the results, and the remaining unselected envelopes were discarded. The piano music group eventually included 112 people, while the control group included 104 people. The researcher scores the participants' anxiety before the examination (using State-Trait Anxiety Inventory [STAI]). The researcher then asked the participants in the control group to wear headphones for electronic colonoscopy without playing music. Participants in the piano music group put on headphones for colonoscopy, while randomly playing music in the music library through the headphones, and the volume could be adjusted by the patients themselves. During the examination, nurses and endoscopists were unaware of the grouping. The same type of colonoscopy (CF-Q260AI, Olympus, Japan) was used for examination. Colonoscopy was done by 5 fixed endoscopists, each with more than 5 years of endoscopic experience, and more than 3000 cases of colonoscopy experiences. During the examination, the electrocardiogram monitor was used to monitor the patient's vital signs and record the patient's vital signs (including heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, respiratory rate, and oxygen saturation) at 3 time points (T0 (before the examination), T1 (5 minutes after the start of the colonoscopy), and T2 (at the end of the examination)). Finally, the researcher assisted the patients and the endoscopists to complete the questionnaire. After the operation, the endoscopists scored the difficulty of the operation, and the researcher rated the participants on anxiety, pain, satisfaction, and assessed their willingness to be examined again.

2.5. Study endpoint

The primary endpoints were patients satisfaction, anxiety, and pain scores, and the secondary endpoints were patients' vital signs, operation difficulty scores, willingness to review the endoscopy, and whether they wanted to listen to music at the next endoscopy. Anxiety scores were assessed by STAI. Satisfaction and pain scores were scored using visual analogue scores. Graded scores were used for endoscopic surgery difficulty scores (easier, average, and harder).

Observation indicators: the systolic blood pressure, diastolic blood pressure, average blood pressure, heart rate, respiratory frequency and oxyhemoglobin saturation of T0 (when the colonoscopy was inserted into the anal orifice), T1 (5 minutes after the colonoscopy screening), and T2 (when the colonoscopy was completed) were monitored and recorded by an electrocardiogram monitor. The STAI was used to assess the degree of anxiety.^[26–28] When using, the research asked the patients fill out the scale and calculated the total score based on the results of the filling. STAI has been cited in more than 14,000 articles and is widely used.^[26] Previous studies^[26,27] have verified the effectiveness of this scale in multiple aspects of STAI, and its Cronbach's alpha is 0.87 to 0.93,^[28] which has good confidence. Studies have shown that Visual analog scale is widely used in pain perception, anxiety, satisfaction and quality of life assessment, and its effectiveness has been confirmed by a large number of studies,^[29–33] and its Cronbach's alpha is 0.86 to 0.95,^[34] which has good confidence.

2.6. Statistical analysis

The data was analyzed by using SPSS 25.0 (SPSS, Chicago, IL). Numeric variables were expressed as mean (standard deviation) or median (interquartile range) values. Categorical variables were given in the form of numbers and percentages. The independent sample *t* test, the Mann–Whitney *U* test, and the chi-square test were used for comparison. When $P < .05$, the results were considered statistically significant.

3. Results

3.1. Characteristics

A total of 216 participants who underwent primary screening colonoscopy were included in the study. There were 112 people in the piano music group and 104 in the control group, and the baseline characteristics of this study were summarized in Table 1. There were no significant differences between the piano music group and the control group in age ($P = .878$), sex ($P = .098$), height ($P = .387$), weight ($P = .110$), education ($P = .330$), history of colonoscopy ($P = .106$), and history of chronic disease ($P = .626$), which were comparable.

3.2. The effect of music on basic vital signs and difficulty of operation

In the study of the effect of music on basic vital signs, it was found that there were no clear differences in heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, respiratory rate, and blood oxygen saturation between the 2 groups at T0, T1 and T2 ($P > .05$), and the results were shown in Table 2. In terms of surgical difficulty evaluation, the difficulty of piano music group was lower than that of the control group ($P = .001$), and the results were shown in Table 3.

3.3. Comparison of experience and willingness of patients undergoing colonoscopy

In terms of patient experience, there was no significant difference in state anxiety score between the music group and the control group before colonoscopy ($P = .140$), while the state anxiety score in the music group after colonoscopy was lower than that in the control group ($P = .017$). There was no significant

difference in trait anxiety score between the 2 groups before and after colonoscopy ($P = .935, .308$). There were statistically significant differences in satisfaction with the colonoscopy process, pain management satisfaction, pain score, and overall service satisfaction between the 2 groups ($P = .000, .045, .009, .008$). The music group preferred to be able to listen to music at the next examination ($P < .001$). However, there was no significant difference in the willingness of the 2 groups to review ($P = .747$). As shown in Table 3.

4. Discussion

In recent years, there has been much studies on the application of music in colonoscopy, but the conclusion has been controversial. Most previous studies did not limit specific information, such as specific music types, instruments, whether there are lyrics, volume, playing time, etc.^[35,36] The lack of specific regulations on the use of music may limit the application of the research results, which may also be an important reason for the inconsistencies in the findings. In this study, the influence of piano light music on colonoscopy was studied for the first time, and the above specific information (light music, piano music, no lyrics, free volume adjustment by the patient, and continuous playing during colonoscopy) was clearly studied for the first time. Some studies have shown that the standard rhythm of light music is about 60 beats per minute, or less than 72 beats^[37] per minute,^[38] and lyrics in different languages may also affect participants differently. Therefore, in this study, we chose piano light music with moderate rhythm and no lyrics. In addition, noise generated by discussions of the disease between the environment and staff may also have an impact on the patient.^[37] Therefore, headphones were used in this study to reduce the influence of the above factors. At the same time, we adopted the method of letting patients wear headphones to play music or not to play music, so as to achieve single blindness and eliminate the influence of music on endoscopic surgeons.

This study evaluated the effects of piano light music on state anxiety and trait anxiety respectively. In this study, the state anxiety score after colonoscopy in the piano music group was significantly lower than that in the control group ($< .05$), and there was no significant difference in the trait anxiety score between the 2 groups before and after colonoscopy ($P > .05$). The above results suggested that piano music could improve the short-term anxiety level of colonoscopy patients, but did not affect long-term anxiety tendencies. Distraction is thought to

Table 1
Baseline characteristics for participants in Piano music group and control group.

Baseline characteristics	Piano music group (n = 112)	Control group (n = 104)	P
Age (yr), mean(SD)	44.71 (13.32)	44.98 (12.09)	.878*
Height (m), mean(SD)	1.66 (0.09)	1.66 (0.08)	.387*
Weight (kg), mean(SD)	61.06 (9.56)	63.34 (11.34)	.110*
Gender, n (%)			
Male	52 (46.43)	60 (57.69)	.098†
Female	60 (53.57)	44 (42.31)	
Education, n (%)			
Education below primary school	16 (14.29)	20 (19.23)	.330†
Education in junior high school or above	96 (85.71)	84 (80.77)	
History of colonoscopy, n (%)			
Yes	48 (42.86)	56 (53.85)	.106†
No	64 (57.14)	48 (46.15)	
Chronic disease history, n (%)			
Yes	20 (17.86)	16 (15.38)	.626†
No	92 (82.14)	88 (84.62)	

SD = standard deviation.

**P* value from independent *t* test.

†*P* value from chi square test.

Table 2
Effects of music on basic vital signs.

Vital signs	Piano music group (n = 112)	Control group (n = 104)	P
Respiration (/min), median (IQR)			
T0	14.00 (13.00–16.00)	15 (13.00–16.00)	.710†
T1	16.00 (14.00–18.00)	16.50 (14.00–19.00)	.109†
T2	15.00 (13.25–16.00)	15.00 (14.00–16.00)	.091†
Heart rate (bpm), median (IQR)			
T0	74.00 (68.00–86.00)	79.00 (69.25–85.00)	.396†
T1	78.00 (71.00–89.25)	75.00 (70.00–89.00)	.270†
T2	75.50 (67.25–89.75)	77.00 (69.00–87.00)	.807†
Oxygen saturation (%), median (IQR)			
T0	98.00 (93.00–99.00)	97.00 (94.00–99.00)	.594†
T1	97.00 (94.00–98.75)	97.50 (95.00–99.00)	.112†
T2	96.00 (93.00–98.00)	96.00 (92.00–97.00)	.176†
Systolic BP (mm Hg), mean (SD)			
T0	123.96 (16.83)	122.08 (18.48)	.433*
T1	110.09 (14.80)	111.55 (14.63)	.467*
T2	115.86 (22.78)	110.19 (19.78)	.053*
Diastolic BP (mm Hg), mean (SD)			
T0	69.43 (11.22)	70.46 (14.83)	.567*
T1	63.96 (9.40)	65.65 (9.94)	.198*
T2	65.25 (9.51)	64.72 (10.55)	.699*
Mean BP (mm Hg), mean(SD)			
T0	87.61 (12.88)	87.67 (15.69)	.976*
T1	79.33 (10.93)	80.95 (10.96)	.279*
T2	82.12 (13.39)	79.88 (13.27)	.218*

BP = arterial blood pressure, IQR = interquartile range, SD = standard deviation, T0 = when the colonoscope is inserted into the anus, T1 = 5 min after colonoscopy insertion, T2 = at the end of the colonoscopy.

*P value from independent t test.

†P value from Mann–Whitney U test.

Table 3
Difficulty of operation and patient experience.

Difficulty of operation and patient experience	Piano music group (n = 112)	Control group (n = 104)	P
Operative difficulty index, n (%)			
Relatively difficult	16 (14.29)§	20 (19.23)§	.001†
General	8 (7.14)§	24 (23.08)§	
Relatively simple	88 (78.57)	60 (57.69)	
State Anxiety Inventor, mean (SD)			
Before colonoscopy	34.71 (9.27)	36.73 (10.71)	.140*
After colonoscopy	30.18 (9.82)	33.20 (8.71)	.017*
Trait Anxiety Inventory, mean(SD)			
Before colonoscopy	36.50 (11.78)	36.38 (10.77)	.935*
After colonoscopy	34.14 (11.90)	35.76 (11.30)	.308*
Satisfaction with the colonoscopy process, mean (SD)	86.14 (20.46)	68.46 (23.60)	.000*
Pain scores, mean (SD)	13.71 (17.77)	20.60 (20.42)	.009*
Pain management satisfaction, mean (SD)	88.54 (15.09)	84.00 (17.70)	.045*
Overall service satisfaction	93.21 (9.79)	86.76 (22.38)	.008*
Willingness to perform colonoscopy again, n (%)			
Yes	84 (75.00)	76 (73.08)	.747†
No	28 (25.00)	28 (26.92)	
Expect to listen to music if the colonoscopy is performed again, n (%)			
Yes	100 (89.29)	52 (50.00)	.000†
No or does not matter	12 (10.71)	52 (50.00)	

SD = standard deviation.

*P value from independent t test.

†P value from chi square test.

§

|| For comparison of intra-group differences, the same symbol indicates no statistical difference, while there is statistical difference between different symbols.

be a mechanism by which music relieves anxiety.^[39] Listening to music can distract patients, isolate distractions, reduce anxiety^[13,40] induced by fear, reduce the level of arousal in anxious people,^[41] and can have a potential sedative effect. Another study found that listening to music could reduce anxiety by increasing brain waves associated with relaxation and reduce activity in brain regions associated with anxiety.^[42] Music can

also increase vagus tone, excites parasympathetic nerves, and ultimately lowers heart rate and anxiety levels by stimulating positive emotions. The reason why piano music failed to improve trait anxiety scores may be that trait anxiety mainly assessed anxiety states over the past period, and the intervention in this study was only performed during colonoscopy and had only short-term effects.

In this study, the heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, respiratory rate, and blood oxygen saturation between the 2 groups at different times, none of the differences among them were statistically significant (T0, T1, T2) ($P > .05$). Previous studies have shown that colonoscopy can cause changes^[43] in blood pressure and heart rate through anxiety.^[6,44] The reason why this change was not found in this study may be because this study only controlled for conditions during colonoscopy, and did not limit conditions before colonoscopy, such as diet and sleep, bowel preparation, specific start time of colonoscopy, etc. Heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, oxygen saturation, and respiratory rate are affected by a variety of factors. In addition, no adverse effects were found in this study, suggesting that it is relatively safe to play piano light music during colonoscopy.

This study found that the difficulty of colonoscopy was significantly reduced in the piano music group ($P < .05$). Previous studies have suggested that anxiety can stimulate the sympathetic-adreno-medullary axis and hypothalamic-pituitary-adrenal axis and activate relevant receptors, resulting in increased blood pressure, increased heart rate, and increased incidence of cardiovascular accidents during examination.^[6,43,44] At the same time, it can improve the patient's wakefulness, alertness, cognition, attention, etc., and reduce the degree of cooperation,^[40,41,43] which may increase the difficulty of colonoscopy. Piano music can improve anxiety, and it is likely that this mechanism makes colonoscopy less difficult.

In terms of patient perception, the pain score and pain management satisfaction of the piano group were significantly better than those of the control group ($P < .05$). Music stimulation can promote the secretion of endorphins in the body, and endorphins have analgesic effects, which can raise the pain threshold and reduce the anxiety caused by pain. Psychological cues may also play a role in subjectively reducing anxiety and pain.^[2] The piano group was better than the control group in terms of satisfaction and overall service satisfaction during colonoscopy ($P = .000, 0.008$). Although the piano music did not change the patient's willingness to undergo colonoscopy again ($P = .747$), the piano music group was more inclined to listen to music at the next examination ($P < .001$), 89.29% of the patients in the piano music group expected to continue to listen music during the next colonoscopy, and 50.00% of the patients in the control group expected to listen music during colonoscopy. To some extent, piano light music is an effective means to improve the satisfaction of enteroscopy. A simple and economical method like playing music should be considered as a routine intervention measure of endoscopy.

There are still some limitations in this study. First, there is subjectivity in the evaluation of the difficulty of endoscopy operation physicians, and the difficulty of the doctor's operation is limited to the division of 3 levels: relatively easy, average, and relatively difficult, which is too subjective and has no exact standard, which may lead to bias caused by each doctor's different standards for difficulty, and the relevant content will be further improved in future studies to make the score more objective; Second, this study only shows the effect of music on patients, but does not explore the effect of music on operating physicians, which will be further reflected in future research; Third, the evaluation of indicators such as pain, anxiety, and satisfaction is recalled after the operation, and there may be recall bias. Fourth, patients who have undergone colonoscopy in the past may be more familiar with the examination process and surrounding environment, and the anxiety level may be lower than that of patients who have not undergone colonoscopy, so colonoscopy in the past may cover up the results of the study to a certain extent. However, these patients may still have a degree of anxiety due to uncertainty about the test results, concerns about the recovery process, and discomfort such as bloating, cramping, and pain during colonoscopy.^[2-4]

and the previous colonoscopy of the 2 groups in this study is similar, so as long as the sample size is sufficient, the effect of light music played by piano on colonoscopy patient satisfaction, anxiety, and pain can still be found. Therefore, whether colonoscopy has been performed in the past has no effect on the findings of this study, and this should be taken into account in future studies, especially if the sample size is relatively small. Fifth, the sample sizes of the 2 groups in this study were inconsistent. The main reason in this study is that, each patient was given an equal amount of opaque envelopes with different groupings written to be grouped, and envelopes that were not selected in each grouping were abandoned. Although this grouping method ensures that the same probability of each participant being assigned to each group, it will have little impact on the research conclusions, which should still be avoided in future studies. This study shows that piano light music can improve anxiety during colonoscopy procedures, thereby achieving potential sedative effects, and we suspect that piano light music can reduce the amount of drugs used in painless and sedative endoscopy, which will be mentioned further in future studies.

5. Conclusion

In summary, piano light music can improve patients' anxiety, improve examination satisfaction, pain management satisfaction and service satisfaction, and potentially reduce the difficulty of colonoscopy, and there are no obvious adverse reactions in treatment, and its advantages of simple operation, economical, noninvasive, and easy acceptance are worthy of clinical promotion.

Author contributions

Conceptualization: Yi-Xiang You.

Data curation: Yi-Xiang You.

Formal analysis: Yi-Xiang You, Da-Zhou Li.

Investigation: Yi-Xiang You, Xiao-Jian He.

Methodology: Xiao-Jian He, Xiang-Peng Zeng, Da-Zhou Li.

Project administration: Xiao-Jian He, Da-Zhou Li.

Resources: Xiao-Jian He, Xiang-Peng Zeng.

Software: Hai-Tao Li.

Supervision: Dong-Jie Sun, Hai-Tao Li, Wen Wang.

Validation: Dong-Jie Sun, Xiang-Peng Zeng, Wen Wang.

Visualization: Dong-Jie Sun, Hai-Tao Li, Wen Wang.

Writing – original draft: Dong-Jie Sun.

Writing – review & editing: Dong-Jie Sun, Hai-Tao Li, Xiang-Peng Zeng, Da-Zhou Li, Wen Wang.

References

- [1] US Preventive Services Task Force; Davidson KW, Barry MJ, Mangione CM, et al. Screening for colorectal cancer: US preventive services task force recommendation statement. *JAMA*. 2021;325:1965–77.
- [2] Ko CH, Chen YY, Wu KT, et al. Effect of music on the level of anxiety in patients undergoing colonoscopy without sedation. *J Chin Med Assoc*. 2017;80:154–60.
- [3] Shafer LA, Walker JR, Waldman C, et al. Factors associated with anxiety about colonoscopy: the preparation, the procedure, and the anticipated findings. *Dig Dis Sci*. 2018;63:610–8.
- [4] Yang C, Sriranjani V, Abou-Setta AM, et al. Anxiety associated with colonoscopy and flexible sigmoidoscopy: a systematic review. *Am J Gastroenterol*. 2018;113:1810–8.
- [5] Dumonceau JM, Riphaus A, Schreiber F, et al. Non-anesthesiologist administration of propofol for gastrointestinal endoscopy: European Society of Gastrointestinal Endoscopy, European Society of Gastroenterology and Endoscopy Nurses and Associates Guideline – updated June 2015. *Endoscopy*. 2015;47:1175–89.
- [6] Celebi D, Yilmaz E, Sahin ST, et al. The effect of music therapy during colonoscopy on pain, anxiety and patient comfort: a randomized controlled trial. *Complement Ther Clin Pract*. 2020;38:101084.

- [7] De Oliveira GS Jr, Holl JL, McCarthy RJ, et al. Overestimation of mortality risk and preoperative anxiety in patients undergoing elective general surgery procedures: a propensity-matched analysis. *Int J Surg*. 2014;12:1473–7.
- [8] Robleda G, Sillero-Sillero A, Puig T, et al. Influence of preoperative emotional state on postoperative pain following orthopedic and trauma surgery. *Rev Lat Am Enfermagem*. 2014;22:785–91.
- [9] Baudet JS, Aguirre-Jaime A. The sedation increases the acceptance of repeat colonoscopies. *Eur J Gastroenterol Hepatol*. 2012;24:775–80.
- [10] Kuhlmann AYR, de Rooij A, Kroese LF, et al. Meta-analysis evaluating music interventions for anxiety and pain in surgery. *Br J Surg*. 2018;105:773–83.
- [11] Wernli KJ, Brenner AT, Rutter CM, et al. Risks associated with anesthesia services during colonoscopy. *Gastroenterology*. 2016;150:888–94.
- [12] Mackay C, Pakenham KI. Identification of stress and coping risk and protective factors associated with changes in adjustment to caring for an adult with mental illness. *J Clin Psychol*. 2011;67:1064–79.
- [13] De Silva AP, Niriella MA, Nandamuni Y, et al. Effect of audio and visual distraction on patients undergoing colonoscopy: a randomized controlled study. *Endosc Int Open*. 2016;4:E1211–E4.
- [14] Sargin M, Ulcer MS, Aydogan E, et al. Anxiety levels in patients undergoing sedation for elective upper gastrointestinal endoscopy and colonoscopy. *Med Arch*. 2016;70:112–5.
- [15] Graversen M, Sommer T. Perioperative music may reduce pain and fatigue in patients undergoing laparoscopic cholecystectomy. *Acta Anaesthesiol Scand*. 2013;57:1010–6.
- [16] Hsu CC, Chen SR, Lee PH, et al. The effect of music listening on pain, heart rate variability, and range of motion in older adults after total knee replacement. *Clin Nurs Res*. 2019;28:529–47.
- [17] Ko SY, Leung DY, Wong EM. Effects of easy listening music intervention on satisfaction, anxiety, and pain in patients undergoing colonoscopy: a pilot randomized controlled trial. *Clin Interv Aging*. 2019;14:977–86.
- [18] Hsu KC, Chen LF, Hsieh PH. Effect of music intervention on burn patients' pain and anxiety during dressing changes. *Burns*. 2016;42:1789–96.
- [19] Hole J, Hirsch M, Ball E, et al. Music as an aid for postoperative recovery in adults: a systematic review and meta-analysis. *Lancet*. 2015;386:1659–71.
- [20] Gramaglia C, Gambaro E, Vecchi C, et al. Outcomes of music therapy interventions in cancer patients – a review of the literature. *Crit Rev Oncol Hematol*. 2019;138:241–54.
- [21] Smith CA, Levett KM, Collins CT, et al. Relaxation techniques for pain management in labor. *Cochrane Database Syst Rev*. 2018;3:CD009514.
- [22] Sorkpor SK, Johnson CM, Santa Maria DM, et al. The effect of music listening on pain in adults undergoing colonoscopy: a systematic review and meta-analysis. *J Perianesth Nurs*. 2021;36:573–80.e1.
- [23] Bechtold ML, Puli SR, Othman MO, et al. Effect of music on patients undergoing colonoscopy: a meta-analysis of randomized controlled trials. *Dig Dis Sci*. 2009;54:19–24.
- [24] Shih YN, Huang RH, Chiang HY. Background music: effects on attention performance. *Work*. 2012;42:573–8.
- [25] Hertzog MA. Considerations in determining sample size for pilot studies. *Res Nurs Health*. 2008;31:180–91.
- [26] Oei TP, Evans L, Crook GM. Utility and validity of the STAI with anxiety disorder patients. *Br J Clin Psychol*. 1990;29:429–32.
- [27] Han Y, Fan J, Wang X, et al. Factor structure and gender invariance of Chinese Version State-Trait Anxiety Inventory (Form Y) in University Students. *Front Psychol*. 2020;11:2228.
- [28] Guillén-Riquelme A, Buéla-Casal G. [Meta-analysis of group comparison and meta-analysis of reliability generalization of the State-Trait Anxiety Inventory Questionnaire (STAI)]. *Rev Esp Salud Publica*. 2014;88:101–12.
- [29] Huskisson EC. Measurement of pain. *Lancet*. 1974;2:1127–31.
- [30] Facco E, Stellini E, Bacci C, et al. Validation of visual analogue scale for anxiety (VAS-A) in preanesthesia evaluation. *Minerva Anesthesiol*. 2013;79:1389–95.
- [31] Freyd M. The graphic rating scale. *J Educ Psychol*. 1923;14:83–102.
- [32] Heller GZ, Manuguerra M, Chow R. How to analyze the visual analogue scale: myths, truths and clinical relevance. *Scand J Pain*. 2016;13:67–5.
- [33] Voutilainen A, Pitkääho T, Kvist T, et al. How to ask about patient satisfaction? The visual analogue scale is less vulnerable to confounding factors and ceiling effect than a symmetric Likert scale. *J Adv Nurs*. 2016;72:946–57.
- [34] Rossi V, Pourtois G. Transient state-dependent fluctuations in anxiety measured using STAI, POMS, PANAS or VAS: a comparative review. *Anxiety Stress Coping*. 2012;25:603–45.
- [35] Bessissow T, Van Keerberghen C-A, Van Oudenhove L, et al. Anxiety is associated with impaired tolerance of colonoscopy preparation in inflammatory bowel disease and controls. *J Crohns Colitis* 2013;7:e580–7.
- [36] Gurbuz-Dogan RN, Ali A, Candy B, et al. The effectiveness of Sufi music for mental health outcomes. A systematic review and meta-analysis of 21 randomised trials. *Complement Ther Med*. 2021;57:102664.
- [37] Wang KC, Lee WL, Wang PH. Anxiety can be reduced by music during colonoscopy examination, but the effect may be varied by musical styles. *J Chin Med Assoc*. 2017;80:326–7.
- [38] Waldon EG, Thom JC. Recorded music in the mental health waiting room: a music medicine investigation. *Arts Psychother*. 2015;7:4617–23.
- [39] Fenko A, Look C. The influence of ambient scent and music on patients' anxiety in a waiting room of a plastic surgeon. *Health Env Res Design J*. 2014;7:38–59.
- [40] Tan DJA, Polascik BA, Kee HM, et al. The effect of perioperative music listening on patient satisfaction, anxiety, and depression: a quasiexperimental study. *Anesthesiol Res Pract*. 2020;2020:3761398.
- [41] Pelletier CL. The effect of music on decreasing arousal due to stress: a meta-analysis. *J Music Ther*. 2004;41:192–214.
- [42] Schafer T, Sedlmeier P, Stadler C, et al. The psychological functions of music listening. *Front Psychol*. 2013;4:511.
- [43] Mifsud KR, Reul J. Mineralocorticoid and glucocorticoid receptor-mediated control of genomic responses to stress in the brain. *Stress*. 2018;21:389–402.
- [44] Chu B, Marwaha K, Sanvictores T, et al. Physiology, stress reaction. *StatPearls*. 2021. Available at: <https://pubmed.ncbi.nlm.nih.gov/31082164/>.