

Effectiveness of non-pharmacological interventions to manage anxiety in adolescents in the perioperative period: A systematic review and meta-analysis

Supplemental material 1: Search strategies

MEDLINE (Pubmed)

Search conducted 26 December 2020

Search	Query	Records retrieved
#1	("Young Adult"[Mesh]) OR "Adolescent"[Mesh]	2 405 294
#2	(((((("Complementary Therapies"[Mesh]) OR "Imagery, Psychotherapy"[Mesh]) OR "Hypnosis"[Mesh:NoExp]) OR "Music Therapy"[Mesh]) OR "Virtual Reality Exposure Therapy"[Mesh]) OR "Massage"[Mesh:NoExp])	227 063
#3	((("Perioperative Care"[Mesh]) OR "Preoperative Care"[Mesh]) OR "Operating Rooms"[Mesh])	162 277
#4	"Anxiety"[Mesh:NoExp]	80 390
#5	(adolescen*[Title/Abstract] OR teen*[Title/Abstract] OR youth*[Title/Abstract] OR paediatric*[Title/Abstract] OR pediatric*[Title/Abstract] OR child*[Title/Abstract])	1768 344
#6	(nonpharmacologic*[Title/Abstract] OR Non-pharmacologic*[Title/Abstract] OR "Non pharmacologic"[Title/Abstract] OR "Non pharmacological"[Title/Abstract] OR "psychological therapy"[Title/Abstract] OR "psychological intervention"[Title/Abstract] OR "Alternative therapy"[Title/Abstract] OR "Alternative therapies"[Title/Abstract] OR "complementary therapy"[Title/Abstract] OR "complementary therapies"[Title/Abstract] OR "guided imagery"[Title/Abstract] OR imagery[Title/Abstract] OR music[Title/Abstract] OR "music therapy"[Title/Abstract] OR "virtual reality"[Title/Abstract] OR hypnosis[Title/Abstract])	81 232
#7	(perioperative[Title/Abstract] OR postoperative[Title/Abstract] OR preoperative[Title/Abstract] OR operati*[Title/Abstract] OR surgery[Title/Abstract] OR "preoperative period"[Title/Abstract])	2 141 446
#8	(anxiety[Title/Abstract] OR "STAIC"[Title/Abstract] OR "STAI"[Title/Abstract] OR "VAS-A"[Title/Abstract] OR "STAI-Y"[Title/Abstract])	190 956
#9	#1 OR #5	3 543 818
#10	#2 OR #6	289 863
#11	#3 OR #7	2 194 676
#12	#4 OR #8	212 892
#13	#9 AND #10 AND #11 AND #12	307
Limited to English, Portuguese, Spanish		290

PsycInfo (EBSCOhost)

Search conducted 26 December 2020

Search	Query	Records retrieved
S1	TI (adolescen* OR teen OR youth* OR paediatric* OR pediatric* OR child*) OR AB (adolescen* OR teen OR youth* OR paediatric* OR pediatric* OR child*)	875 489
S2	TI (nonpharmacologic* OR Nonpharmacologic* OR "Non pharmacologic" OR "Non pharmacological" OR "psychological therapy" OR "psychological intervention" OR "Alternative therapy" OR "Alternative therapies" OR "complementary therapy" OR "complementary therapies" OR "guided imagery" OR imagery OR music OR "music therapy" OR "virtual reality" OR hypnosis) OR AB (nonpharmacologic* OR Nonpharmacologic* OR "Non pharmacologic" OR "Non pharmacological" OR "psychological therapy" OR "psychological intervention" OR "Alternative therapy" OR "Alternative therapies" OR "complementary therapy" OR "complementary therapies" OR "guided imagery" OR imagery OR music OR "music therapy" OR "virtual reality" OR hypnosis)	73 717
S3	TI (perioperative OR postoperative OR preoperative OR operati* OR surgery OR "preoperative period") OR AB (perioperative OR postoperative OR preoperative OR operati* OR surgery OR "preoperative period")	136 217
S4	TI (anxiety OR "STAIC" OR "STAI" OR "VAS-A" OR "STAI-Y") OR AB (anxiety OR "STAIC" OR "STAI" OR "VAS-A" OR "STAI-Y")	197 134
S5	MA adolescents OR teenagers OR teen OR youth	258 490
S6	MA complementary therapy	258 490
S7	MA perioperative OR peri-operative OR preoperative OR preoperative OR post-operative OR postoperative OR surgical	7 335
S8	MA anxiety	52 853
S9	S1 OR S5	1 023 122
S10	S2 OR S6	74 902
S11	S3 OR S7	138 397
S12	S4 OR S8	210 553
S13	S9 AND S10 AND S11 AND S12	47
Limited to Spanish, English, Portuguese		43

CINHAL Complete (EBSCOhost)

Search conducted 26 December 2020

Search	Query	Records retrieved
S1	TI (adolescen* OR teen OR youth* OR paediatric* OR pediatric* OR child*) OR AB (adolescen* OR teen OR youth* OR paediatric* OR pediatric* OR child*)	709 066
S2	TI (nonpharmacologic* OR Nonpharmacologic* OR "Non pharmacologic" OR "Non pharmacological" OR "psychological therapy" OR "psychological intervention" OR "Alternative therapy" OR "Alternative therapies" OR "complementary therapy" OR "complementary therapies" OR "guided imagery" OR imagery OR music OR "music therapy" OR "virtual reality" OR hypnosis) OR AB (nonpharmacologic* OR Nonpharmacologic* OR "Non pharmacologic" OR "Non pharmacological" OR "psychological therapy" OR "psychological intervention" OR "Alternative therapy" OR "Alternative therapies" OR "complementary therapy" OR "complementary therapies" OR "guided imagery" OR imagery OR music OR "music therapy" OR "virtual reality" OR hypnosis)	38 503
S3	TI (perioperative OR postoperative OR preoperative OR operati* OR surgery OR "preoperative period") OR AB (perioperative OR postoperative OR preoperative OR operati* OR surgery OR "preoperative period")	431 958
S4	TI (anxiety OR "STAIC" OR "STAI" OR "VAS-A" OR "STAI-Y") OR AB (anxiety OR "anxiety level" OR "STAIC" OR "STAI" OR "VAS-A" OR "STAI-Y")	99 342
S5	MH adolescence	566 153
S6	MH hypnosis OR massage OR virtual reality	24 093
S7	MH preoperative period	6 123
S8	MH anxiety	46 839
S9	S1 OR S5	1 031 305
S10	S2 OR S6	58 091
S11	S3 OR S7	433 119
S12	S4 OR S8	114 647
S13	S9 AND S10 AND S11 AND S12	97
Limited to Spanish, English, Portuguese		93

Cochrane Central Register of Controlled Trials (EBSCOhost)

Search conducted 26 December 2020

Search	Query	Records retrieved
S1	TI (adolescen* OR teen OR youth* OR paediatric* OR pediatric* OR child*) OR AB (adolescen* OR teen OR youth* OR paediatric* OR pediatric* OR child*)	161 986
S2	TI (nonpharmacologic* OR Nonpharmacologic* OR "Non pharmacologic" OR "Non pharmacological" OR "psychological therapy" OR "psychological intervention" OR "Alternative therapy" OR "Alternative therapies" OR "complementary therapy" OR "complementary therapies" OR "guided imagery" OR imagery OR music OR "music therapy" OR "virtual reality" OR hypnosis) OR AB (nonpharmacologic* OR Nonpharmacologic* OR "Non pharmacologic" OR "Non pharmacological" OR "psychological therapy" OR "psychological intervention" OR "Alternative therapy" OR "Alternative therapies" OR "complementary therapy" OR "complementary therapies" OR "guided imagery" OR imagery OR music OR "music therapy" OR "virtual reality" OR hypnosis)	18 505
S3	TI (perioperative OR postoperative OR preoperative OR operati* OR surgery OR "preoperative period") OR AB (perioperative OR postoperative OR preoperative OR operati* OR surgery OR "preoperative period")	230 423
S4	TI (anxiety OR "STAIC" OR "STAI" OR "VAS-A" OR "STAI-Y") OR AB (anxiety OR "anxiety level" OR "STAIC" OR "STAI" OR "VAS-A" OR "STAI-Y")	73 218
S5	MH adolescent	102 689
S6	MH hypnosis OR massage OR virtual reality	911
S7	MH preoperative period	263
S8	MH anxiety	867
S9	S1 OR S5	241 939
S10	S2 OR S6	19 111
S11	S3 OR S7	230 447
S12	S4 OR S8	73 512
S13	S9 AND S10 AND S11 AND S12	169
Limited to Spanish, English, Portuguese		84

SciELO

Search conducted 26 December 2020

Search	Query	Records retrieved
#1	(ti:(adolescen* OR teen OR youth* OR paediatric* OR pediatric* OR child*)) OR (ab:(adolescen* OR teen OR youth* OR paediatric* OR pediatric* OR child*))	70 497
#2	(ti:(nonpharmacologic* OR Non-pharmacologic* OR "Non pharmacologic" OR "Non pharmacological" OR "psychological therapy" OR "psychological intervention" OR "Alternative therapy" OR "Alternative therapies" OR "complementary therapy" OR "complementary therapies" OR "guided imagery" OR imagery OR music OR "music therapy" OR "virtual reality" OR hypnosis)) OR (ab:(nonpharmacologic* OR Non-pharmacologic* OR "Non pharmacologic" OR "Non pharmacological" OR "psychological therapy" OR "psychological intervention" OR "Alternative therapy" OR "Alternative therapies" OR "complementary therapy" OR "complementary therapies" OR "guided imagery" OR imagery OR music OR "music therapy" OR "virtual reality" OR hypnosis))	149 694
#3	(ti:(perioperative OR postoperative OR preoperative OR operati* OR surgery OR "preoperative period")) OR (ab:(perioperative OR postoperative OR preoperative OR operati* OR surgery OR "preoperative period"))	49 259
#4	(ti:(anxiety OR "STAI" OR "STAI" OR "VAS-A" OR "STAI-Y")) OR (ab:(anxiety OR "anxiety level" OR "STAI" OR "STAI" OR "VAS-A" OR "STAI-Y"))	5 241
#5	#1 AND #2 AND #3 AND #4	3 912
Limited to Spanish, English, Portuguese		462

Open Gray–System for Information on Gray Literature in Europe

Search conducted 26 December 2020

Search	Query	Records retrieved
#1	Adolescen* AND surgery AND anxiety	2

RCAAP – Repositório Científico de Acesso Aberto de Portugal (Portugal)

Search conducted 26 December 2020

Search	Query	Records retrieved
#1	Adolescen* AND surgery AND anxiety	11

Effectiveness of non-pharmacological interventions to manage anxiety in adolescents in the perioperative period: A systematic review and meta-analysis

Supplemental material 2: Studies ineligible following full-text review

Study	Reason for exclusion
1. Arnon Z, Hanan H, Mogilner J. The effect of a hypnotic-based animated video on stress and pain reduction in pediatric surgery. <i>Int J Clin Exp Hypn</i> 2018;66(2):123–133.	Ineligible population and outcomes of interest not clearly defined.
2. Augustin P, Hains AA. Effect of music on ambulatory surgery patients' preoperative anxiety. <i>AORN J</i> 1996;63(4):750, 3–8.	Ineligible population.
3. Aytekin A, Doru O, Kucukoglu S. The Effects of Distraction on Preoperative Anxiety Level in Children. <i>J Perianesth Nurs</i> 2016;31(1):56–62.	The authors sent several emails to the article author (AA) asking for how many nine-year-old children they include in the study sample and they never got any answer.
4. Coşkuntürk AE, Gözen D. The effect of interactive therapeutic play education program on anxiety levels of children undergoing cardiac surgery and their mothers. <i>J Perianesth Nurs</i> 2018;33(6):781–789.	Ineligible outcome.
5. Bailey PD, Jr., Bastien JL. Preinduction techniques for pediatric anesthesia. <i>Curr Opin Anaesthesiol</i> 2005;18(3):265–269.	Ineligible study design.
6. Borimnejad L, Arbabi N, Seydfatemi N, Inanloo M, Haghani H. The effects of acupressure on preoperative anxiety reduction in school aged children. <i>Healthmed</i> 2012;6(7):2359–2361.	Ineligible outcome.
7. Borji M, Pouy S, Yaghobi Y, Nabi BN. Effectiveness of acupressure on anxiety of children undergoing anesthesia. <i>Int J Adolesc Med Health</i> 2019.	Ineligible population.
8. Calipel S, Lucas-Polomeni MM, Wodey E, Ecoffey C. Premedication in children: Hypnosis versus midazolam. <i>Paediatr Anaesth</i> 2005;15(4):275–281.	Ineligible population.
9. Carlsson RNE, Henningsson RN. Visiting the operating theatre before surgery did not reduce the anxiety in children and their attendant parent. <i>J Pediatr Nurs</i> 2018;38:e24–e29.	Ineligible outcome.
10. Fernandes SC, Arriaga P. The effects of clown intervention on worries and emotional responses in children undergoing surgery. <i>J Health Psychol</i> 2010;15(3):405–415.	Ineligible population.
11. Dehghan F, Jalali R, Bashiri H. The effect of virtual reality technology on preoperative anxiety in children: A Solomon four-group randomized clinical trial. <i>Perioper Med (Lond)</i> 2019;8:5.	Ineligible population.
12. Eijlers R, Legerstee JS, Dierckx B, Staals LM, Berghmans J, van der Schroeffer MP et al. development of a virtual reality exposure tool as psychological preparation for elective pediatric day care surgery: Methodological approach for a randomized controlled trial. <i>JMIR Res Protoc</i> 2017;6(9):e174.	Ineligible outcome.

Study	Reason for exclusion
13. Eijlers R, Dierckx B, Staals LM, Berghmans JM, van der Schroeffer MP, Strabbing EM et al. Virtual reality exposure before elective day care surgery to reduce anxiety and pain in children: A randomised controlled trial. <i>Eur J Anaesthesiol</i> 2019;36(10):728–737.	Ineligible population.
14. Fancourt D, Lee C, Baltzer Nielsen S, Capps S, Brooks P. Relax anaesthetics: The effect of a bespoke distraction app on anxiety levels in children undergoing induction of anaesthesia. <i>Anesth Analg</i> 2016;123(3):298–299.	Ineligible outcome.
15. Franzoi MA, Goulart CB, Lara EO, Martins G. Music listening for anxiety relief in children in the preoperative period: A randomized clinical trial. <i>Rev Lat Am Enfermagem</i> 2016;24:e2841.	Ineligible population.
16. Huth MM, Broome ME, Good M. Imagery reduces children's post-operative pain. <i>Pain</i> 2004;110(1–2):439–448.	Ineligible outcome.
17. Kain ZN, Wang SM, Mayes LC, Krivutza DM, Teague BA. Sensory stimuli and anxiety in children undergoing surgery: A randomized, controlled trial. <i>Anesth Analg</i> 2001;92(4):897–903.	Ineligible population.
18. Kain ZN, Caldwell-Andrews AA, Krivutza DM, Weinberg ME, Gaal D, Wang SM et al. Interactive music therapy as a treatment for preoperative anxiety in children: A randomized controlled trial. <i>Anesth Analg</i> 2004;98(5):1260–1266, table of contents.	Ineligible population.
19. Karakul A, Bolışık ZB. The effect of music listened to during the recovery period after day surgery on the anxiety state and vital signs of children and adolescents. <i>J Ped Res</i> 2018;5(2):82–87.	The authors sent an email to the article author (AK) asking for how many nine-year-old children they include in the study sample. The author answered 28 children. After that, the authors asked if it would be possible to get the output results excluding the nine-year-old children. The article author (AK) answered yes, but never sent it or answered subsequent emails.
20. Kassai B, Rabilloud M, Dantony E, Grousseau S, Revol O, Malik S et al. Introduction of a paediatric anaesthesia comic information leaflet reduced preoperative anxiety in children. <i>BJA: Br J Anaesth</i> 2016;117(1):95–102.	Ineligible population. No specific results for adolescent population.
21. Ko JS, Whiting Z, Nguyen C, Liu RW, Gilmore A. A randomized prospective study of the use of ipads in reducing anxiety during cast room procedures. <i>Iowa Orthop J</i> 2016;36:128–132.	Ineligible outcome.
22. Kocherov S, Hen Y, Jaworowski S, Ostrovsky I, Eidelman AI, Gozal Y et al. Medical clowns reduce pre-operative anxiety, post-operative pain and medical costs in children undergoing outpatient penile surgery: A randomised controlled trial. <i>J Paediatr Child Health</i> 2016;52(9):877–881.	Ineligible outcome. An email was sent to the author (SK) and he answered that he doesn't have the database anymore.
23. Kumar A, Das S, Chauhan S, Kiran U, Satapathy S. Perioperative anxiety and stress in children undergoing congenital cardiac surgery and their parents: Effect of brief intervention-a randomized control trial. <i>J Cardiothorac Vasc Anesth</i> 2019;33(5):1244–1250.	Ineligible outcome.
24. Lambert SA. The effects of hypnosis/guided imagery on the postoperative course of children. <i>J Dev Behav Pediatr</i> 1996;17(5):307–310.	Ineligible outcome.

Study	Reason for exclusion
25. Li HC, Lopez V, Lee TL. Psychoeducational preparation of children for surgery: the importance of parental involvement. <i>Patient Educ Couns</i> 2007;65(1):34–41.	Ineligible outcome.
26. Li HC. Evaluating the effectiveness of preoperative interventions: the appropriateness of using the Children's Emotional Manifestation Scale. <i>J Clin Nurs</i> 2007;16(10):1919–1926.	Ineligible outcome.
27. Li HC, Lopez V. Effectiveness and appropriateness of therapeutic play intervention in preparing children for surgery: A randomized controlled trial study. <i>J Spec Pediatr Nurs</i> 2008;13(2):63–73.	Ineligible outcome.
28. Li WH, Chan SS, Wong EM, Kwok MC, Lee IT. Effect of therapeutic play on pre- and post-operative anxiety and emotional responses in Hong Kong Chinese children: A randomised controlled trial. <i>Hong Kong Med J</i> . 2014;20 Suppl 7:36–39.	Ineligible outcome.
29. Mainer JA. Nonpharmacological interventions for assisting the induction of anesthesia in children. <i>AORN J</i> 2010;92(2):209–210.	Ineligible study design.
30. Messina M, Molinaro F, Meucci D, Angotti R, Giuntini L, Cerchia E et al. Preoperative distraction in children: Hand-held videogames vs clown therapy. <i>Pediatr Med Chir</i> 2014;36(5–6):98.	Ineligible outcome.
31. Millett CR, Gooding LF. Comparing active and passive distraction-based music therapy interventions on preoperative anxiety in pediatric patients and their caregivers. <i>J Music Ther</i> 2018;54(4):460–478.	Ineligible population.
32. Moro ET, Módolo NS. [Children, parents and anxiety.]. <i>Rev Bras Anesthesiol</i> . 2004;54(5):728–738.	Ineligible study design.
33. Nilsson S, Kokinsky E, Nilsson U, Sidenvall B, Enskär K. School-aged children's experiences of postoperative music medicine on pain, distress, and anxiety. <i>Paediatr Anaesth</i> . 2009;19(12):1184–90.	No specific results for adolescent population.
34. O'Conner-Von, S. Preparation of adolescents for outpatient surgery: Using an internet program. <i>AORN J</i> 2008, 87(2), 374–398.	Ineligible study design.
35. Park JW, Nahm FS, Kim JH, Jeon YT, Ryu JH, Han SH. The effect of mirroring display of virtual reality tour of the operating theatre on preoperative anxiety: A randomized controlled trial. <i>IEEE J Biomed Health Inform</i> 2019;23(6):2655–2660.	Ineligible population.
36. Rhodes R, Nash C, Moisan A, Scott DC, Barkoh K, Warner WC et al. Does preoperative orientation and education alleviate anxiety in posterior spinal fusion patients? A prospective, randomized study. <i>J Pediatr Orthop</i> 2015;35(3):276–279.	Ineligible outcome.
37. Robinson PJ, Kobayashi K. Development and evaluation of a presurgical preparation program. <i>J Pediatr Psychol</i> 1991;16(2):193–212.	Ineligible outcome.
38. Rodriguez S, Caruso T, Tsui B. Bedside entertainment and relaxation theater: Size and novelty does matter when using video distraction for perioperative pediatric anxiety. <i>Paediatr Anaesth</i> 2017;27(6):668–669.	Ineligible study design.
39. Robb SL, Nichols RJ, Rutan RL, Bishop BL, Parker JC. The effects of music-assisted relaxation on preoperative anxiety. <i>J Music Ther</i> 1995;32(1):2–21.	Ineligible population. No specific results for adolescent population.

Study	Reason for exclusion
40. Ryu JH, Park JW, Nahm FS, Jeon YT, Oh AY, Lee HJ et al. The effect of gamification through a virtual reality on preoperative anxiety in pediatric patients undergoing general anesthesia: A prospective, randomized, and controlled trial. <i>J Clin Med</i> 2018;7(9).	Ineligible population.
41. Ryu JH, Park SJ, Park JW, Kim JW, Yoo HJ, Kim TW et al. Randomized clinical trial of immersive virtual reality tour of the operating theatre in children before anaesthesia. <i>Br J Surg</i> 2017;104(12):1628–1633.	Ineligible population.
42. Ryu JH, Oh AY, Yoo HJ, Kim JH, Park JW, Han SH. The effect of an immersive virtual reality tour of the operating theater on emergence delirium in children undergoing general anesthesia: A randomized controlled trial. <i>Paediatr Anaesth</i> 2019;29(1):98–105.	Ineligible population.
43. Sagredini R, Mascheroni C, Diotto V, Tranquillini E, Paracchini F, Mercuri P. Treatment of anxiety at induction of anaesthesia in children: a randomized controlled trial of non-pharmacological approach versus midazolam or placebo. <i>Paediatr anaesth</i> 2013;23(3):285.	Ineligible study design.
44. Scheel T, Hoepfner D, Grotevendt A, Barthlen W. clowns in paediatric surgery: Less anxiety and more oxytocin? A pilot study. <i>Klin Padiatr</i> 2017;229(5):274–280.	Ineligible outcome.
45. Sola C, Lefauconnier A, Bringuier S, Raux O, Capdevila X, Dadure C. Childhood preoperative anxiolysis: Is sedation and distraction better than either alone? A prospective randomized study. <i>Paediatr Anaesth</i> 2017;27(8):827–834.	Ineligible outcome.
46. Soliveres J, Sánchez A, Balaguer J, Estruch M, Sánchez J, Solaz C. Parental presence in the operating room: Effect on the quality of anesthetic induction and postoperative agitation in children. <i>Rev Esp Anesthesiol Reanim</i> 2011;58(8):472–476.	Ineligible population.
47. Staveski SL, Boulanger K, Erman L, Lin L, Almgren C, Journal C et al. The impact of massage and reading on children's pain and anxiety after cardiovascular surgery: A pilot study. <i>Pediatr Crit Care Med</i> 2018;19(8):725–732.	Ineligible population. No specific results for adolescent population.
48. Strom S. Preoperative evaluation, premedication, and induction of anesthesia in infants and children. <i>Curr Opin Anaesthesiol</i> 2012;25(3):321–325.	Ineligible study design.
49. Vagnoli L, Bettini A, Amore E, De Masi S, Messeri A. Relaxation-guided imagery reduces perioperative anxiety and pain in children: A randomized study. <i>Eur J Pediatr</i> 2019;178(6):913–921.	Ineligible population and outcomes of interest not clearly defined.
50. Verschueren S, van Aalst J, Bangels AM, Toelen J, Allegaert K, Buffel C et al. Development of CliniPup, a serious game aimed at reducing perioperative anxiety and pain in children: Mixed methods study. <i>JMIR Serious Games</i> 2019;7(2):e12429.	Ineligible population.
51. Wang ZX, Liu SL, Sun CH, Wang Q. Psychological intervention reduces postembolization pain during hepatic arterial chemoembolization therapy: A complementary approach to drug analgesia. <i>World J Gastroenterol</i> 2008;14(6):931–935.	Ineligible intervention.
52. Whipple J. Surgery Buddies: A music therapy program for pediatric surgical patients. music therapy perspectives. 2003;21(2):77–83.	Ineligible study design.
53. William Li HC, Lopez V, Lee TL. Effects of preoperative therapeutic play on outcomes of school-age children undergoing day surgery. <i>Res Nurs Health</i> 2007;30(3):320–332.	Ineligible outcome.