Effectiveness of hospital clowns for symptom management in paediatrics: systematic review of randomised and non-randomised controlled trials

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ABSTRACT

OBJECTIVE

To evaluate evidence from randomised controlled trials and non-randomised controlled trials on the effectiveness of hospital clowns for a range of symptom clusters in children and adolescents admitted to hospital with acute and chronic conditions.

DESIGN

Systematic review of randomised and non-randomised controlled trials.

DATA SOURCES

Medline, ISI of Knowledge, Cochrane Central Register of Controlled Trials, Science Direct, Scopus, American Psychological Association PsycINFO, Cumulative Index to Nursing and Allied Health Literature, and Latin American and Caribbean Health Sciences Literature.

STUDY SELECTION

Randomised and non-randomised controlled trials were peer reviewed using the following eligibility criteria: children and adolescents who were admitted to hospital for acute conditions or chronic disorders, studies comparing use of hospital clowns with standard care, and studies evaluating the effect of hospital clowns on symptom management of inpatient children and adolescents as a primary outcome.

DATA EXTRACTION AND SYNTHESIS

Two investigators independently screened studies, extracted data, and appraised the risk of bias. Methodological appraisal was assessed by two investigators independently using the Jadad scale, the revised Cochrane risk-of-bias tool for randomised controlled trials (RoB 2), and the risk of bias in non-randomised studies (ROBINS-I) tool for non-randomised controlled trials.

RESULTS

24 studies (n=1612) met the inclusion criteria for data extraction and analysis. Most studies were randomised controlled trials (n=13). Anxiety was the most frequently analysed symptom (n=13), followed by pain (n=9), psychological and emotional responses and perceived wellbeing (n=4), stress (n=4), cancer related fatigue (n=3), and crying (n=2). Five studies used biomarkers, mainly cortisol, to assess stress or fatigue outcome following hospital clowns. Most of the randomised controlled trials (n=11; 85%) were rated as showing some concerns, and two trials were rated with a high risk of bias. Most non-randomised controlled trials (n=6; 55%) were rated with a moderate risk of bias according to ROBINS-I tool. Studies showed that children and adolescents who were in the presence of hospital clowns, either with or without a parent present, reported significantly less anxiety during a range of medical procedures, as well as improved psychological adjustment ($P<0.05$). Three studies that evaluated chronic conditions showed favourable results for the intervention of hospital clowns with significant reduction in stress, fatigue, pain, and distress ($P<0.05$).

CONCLUSIONS

These findings suggest that the presence of hospital clowns during medical procedures, induction of anaesthesia in the preoperative room, and as part of routine care for chronic conditions might be a beneficial strategy to manage some symptom clusters. Furthermore, hospital clowns might help improve psychological wellbeing in admitted children and adolescents with acute and chronic disorders, compared with those who received only standard care.

SYSTEMATIC REVIEW REGISTRATION

PROSPERO CRD42018107099.

WHAT IS ALREADY KNOWN ON THIS TOPIC

Hospital clown intervention has been shown to have a positive effect on paediatric patient outcomes for acute conditions and during medical procedures

WHAT THIS STUDY ADDS

This systematic review included 24 studies with 1612 children and adolescents

Results indicated that interaction with hospital clowns during medical procedures, during induction of anaesthesia, in the preoperative room, and in chronic conditions (such as cancer) might be a beneficial strategy to manage symptom clusters (eg, anxiety, stress, pain, and fatigue) and improve psychological adjustment of children and adolescents in hospital compared with those in control groups with standard care

Hospital clowns might contribute to improved psychological wellbeing and emotional responses in children and adolescents in hospital with acute or chronic conditions

Introduction

The scientific literature is consistent in validating wellbeing, self-confidence, and psychological processes as factors for recovery and response to treatment, and these benefits could be related to their effect on the host immune response.[1-3] Procedures and treatments performed in hospital settings can increase patient burden, especially in admitted children and adolescents, and can require specific strategies to help these patients cope with being in hospital

and different symptom clusters.[2-6] Thus, alleviating symptom clusters during the admission process has become a priority in paediatric care.[7-13] Since the emergence of hospital clowns in North America in the 1980s, it has become a popular practice in paediatric settings, mainly in acute and rehabilitation hospitals worldwide.[14] Hospital clowns have a positive effect on paediatric patient outcomes, mainly in patients with acute conditions and during medical procedures.[14-20] Hospital clowns are also increasingly thought to have a complementary role in healthcare by easing the recovery of these patients.[14 15]

Previous reviews and meta-analyses have assessed the effects of hospital clowns.[18 21 22] One study concluded that hospital clowns had a substantial role in reducing stress and anxiety in children staying in a paediatric ward or undergoing invasive procedures or minor surgery involving anaesthesia, as well as in their parents.[18] Another study confirmed the strong effect of hospital clowns in reducing the psychological distress of children just before surgery.[21] The last study, which assessed the effectiveness of clowning on anxiety in children undergoing procedures, suggested that clowning seems to reduce children's anxiety. However, given the increased risk of bias of included studies and the very low quality of evidence, these results should be considered with caution.[22] Previous similar studies focused exclusively on acute conditions, and one review lacked a specific tool for a risk-of-bias analysis.[18] Our systematic review explores the effects of hospital clowns in paediatric hospital settings from the standpoint of symptom clustering, expanding on the above mentioned studies to identify recently published methodological and scientific progress (up to February 2020).

In this systematic review, we evaluated evidence from randomised and non-randomised controlled trials on the effectiveness of hospital clowns for several symptom clusters (including acute and chronic conditions) in children and adolescents in various paediatric hospital settings. Trial quality was assessed by the recently revised Cochrane risk-of-bias tool (RoB 2)[23] and the methodological appraisal tool ROBINS-I (risk of bias in non-randomised studies of interventions).[24]

What are hospital clowns?

Clowns are comic performers who use theatrical production (often in a mime style) and outlandish and brightly coloured costumes to entertain a given public. In a hospital setting, hospital clowns are usually part of therapeutic clowning programmes, which are also known as hospital clowning or clown care programmes. The first modern register of hospital clowning was reported in September 1908 in the Parisian newspaper *Le Petit Journal*, which depicted on its front page an illustration of clowns and children in a London hospital ward (fig 1).[25] The American physician Patch Adams started clowning for patients in the mid-1970s, and has been considered a pioneer in therapeutic clowning. In the mid-1980s, two models of hospital clowning originated independently in North America: clown doctors, which originated in New York City, NY, United States; and therapeutic clowns, which operate within the child life programmes and originated in Manitoba, ON, Canada. Hospital clowning continues to grow around the world, but each country operates differently in terms of professional standards and training.[14 15] Many hospital clowning programmes currently operate in Australia,[26] New Zealand,[27] the US,[15] United Kingdom,[14] Canada,[15] Israel,[28] South Africa,[29] Hong Kong,[14 15] Brazil,[30] Belarus,[14] several countries in Europe,[14 15] and India.[31]

In general, clown doctors provide a complementary form of healthcare by using techniques such as music, juggling, improvisation, magic, storytelling, and puppetry, to entertain children and adolescents in hospital; they also visit adults in some hospitals.[14 15 25] The clown doctors help create a positive emotional state and environment that promotes interaction between parents and child and foster a hopeful attitude. With a high level of adaptability, sensitiveness, and attentiveness, clown doctors adapt their toolbox to each patient, situation, and medical procedure being performed. With the saying "laughter is the best medicine," the healing power of humour is used by clown doctors to deal with the psychosocial needs of inpatients and support emotional expression and empowerment. As hospital clowning continues to grow in many countries, studies on humour research, play research, and the physiological health benefits on laughter have also been conducted[14 15 25]

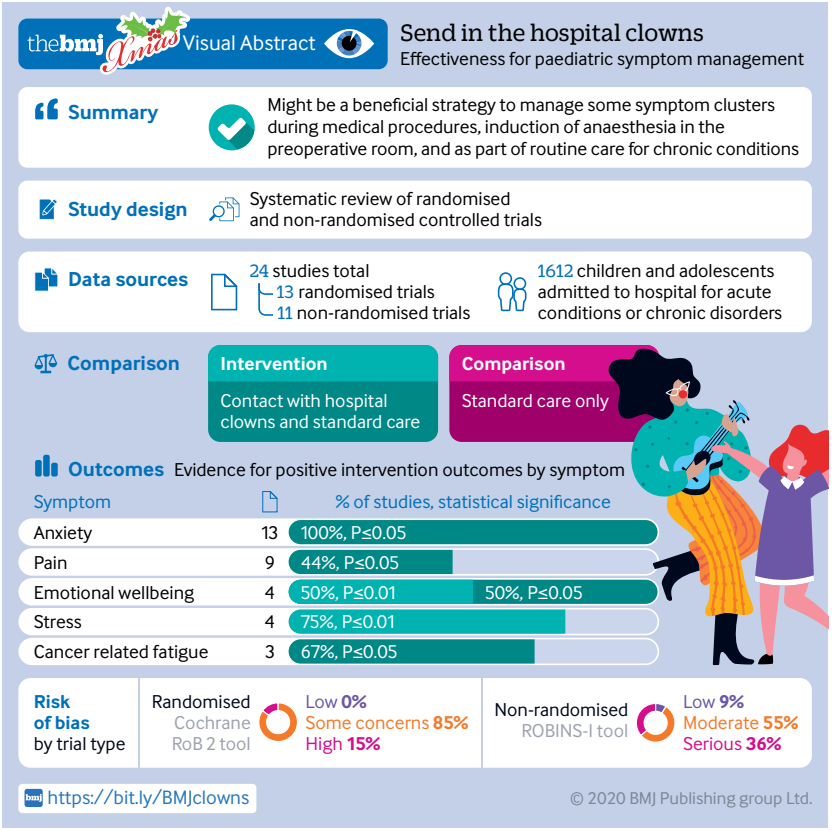

Fig 1 | Illustration of hospital clowns, shown on the front cover of the September 1908 issue of Parisian newspaper *Le Petit Journal*[25]

Methods

This systematic review is reported according to the PRISMA (preferred reporting items for systematic reviews and meta-analyses) guidelines.[32] We did a systematic review of randomised and non-randomised controlled trials on the effectiveness of hospital clowns for a range of symptom clusters in children and adolescents with acute and chronic conditions in paediatric hospital settings. This systematic review used the methods of the Cochrane Handbook for Systematic Reviews of Interventions, version 5.1.0. In addition, the study protocol was developed using guidance from the PRISMA protocols,[33] registered in PROSPERO (CRD42018107099), and have been published elsewhere.[34]

Search strategy and study selection

The search strategy was elaborated and implemented before study selection according to PRISMA.[32] Using the PICOS strategy (population, intervention, comparison, outcome, and study design),[35 36] we asked the following question to conduct the systematic review of available literature: "What is the effect of hospital clowns for symptom management in hospitalised children and adolescents?"[34] With a medical librarian, we did a comprehensive systematic search (from inception in 1947 up to 29 February 2020) using the following electronic databases: Medline (Medical Literature Analysis and Retrieval System Online), ISI of Knowledge, Cochrane Central Register of Controlled Trials, Science Direct, Sci-Verse Scopus, American Psychological Association PsycINFO, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and Latin American and Caribbean Health Sciences Literature (LILACS). We did not restrict the search to language or date, to avoid reducing the yield and to increase representability and generalisability. We also scrutinised the reference lists of studies found in the search for additional relevant articles.

In addition to the electronic databases mentioned above, we did secondary searches using other sources (eg, Google Scholar, Scientific Electronic Library Online (SciELO)) and clinical trials records sites (eg, ClinicalTrials.gov and the Brazilian Clinical Trials Registry (ReBEC)). The list of final articles retrieved from the search was also analysed manually to identify relevant studies to be added. We included articles published in any language that were peer reviewed and that met the eligibility criteria based on the PICOS strategy:

- Population (P): children and adolescents who were admitted to hospital for acute conditions or chronic disorders
- Intervention (I): receiving hospital clowns intervention
- Comparison (C): compared receipt of hospital clowns to standard of care
- Outcome (O): evaluated the effect of hospital clowns on symptom clusters of children and adolescents in hospital as a primary outcome
- Study design (S): randomised controlled trial or non-randomised controlled trial.

All the non-primary literature were excluded, such as literature reviews, dissertations, theses, editorials, protocol studies, and clinical guidelines.[34]

Initially, the existence of controlled descriptors (such as MeSH terms, CINAHL headings, PsycINFO thesaurus, and DeCS-Health Science Descriptors) and their synonyms (keywords) was verified in each database. We combined the search terms using the Boolean operators "AND" and "OR."[37-39] Subsequently, we used a search strategy combining MeSH terms and free text words (eg, "(child OR child, hospitalized OR adolescent OR adolescent, hospitalized OR paediatrics) AND (clown doctors OR clown intervention OR clowns OR therapeutic clown OR clowns in hospital OR hospital clowns) AND (symptoms OR affective symptoms OR behavioural symptoms OR symptom clusters OR clusters of neuropsychological symptoms OR neuropsychological symptoms OR anxiety OR stress, psychological OR distress OR psychological impact)").

The search strategy as well as the selection of studies were conducted independently by two reviewers (LCL-J and EB). After this selection, a third reviewer (ETN) was responsible for analysing and reaching consensus with the previous reviewers on the inclusion or exclusion of each article and regarding any conflicting decisions. After the selection of the third reviewer, a manual search was performed to review the references of the selected articles. Additionally, Cohen's κ was used to measure intercoder agreement in each screening phase of this systematic review. We used the bibliographic

software EndNote (www.myendnoteweb.com/) to store, organise, and manage all the references and ensure a systematic and comprehensive search.

Data extraction and quality assessment

Two researchers (LCL-J and EB) independently analysed titles and abstracts of all the references retrieved from the databases, separating them into three groups: include, possibly include, and exclude. When the reviewers disagreed, the article was re-evaluated. If the disagreement persisted, a third reviewer (ETN) made a final decision. Using standardised forms,[40-43] two authors (LCL-J and EB) independently extracted data, and clarifications on the following four areas were requested from the study's authors when necessary:

- Identification of the study (article title, journal title, journal impact factor, authors, country of the study, language, publication year, host institution of the study (hospital, university, research centre, single institution, multicentre study), conflict of interest, and study sponsorship
- Methodological characteristics (study design; study objective, research question, or hypothesis; sample characteristics (eg, sample size, age, race, baseline characteristics); groups and controls; recruitment methods and study completion rates; stated length of follow-up; validated measures; and statistical analyses and adjustments)
- Main findings and implications for clinical practice
- Conclusions.

Because most studies did not report association or effect measures, data were extracted and reported on the basis of the means and standard deviation of each outcome as well as the results of inferential statistics (mostly bivariate analyses) and respective confidence intervals and P values (comparing the experimental and control groups).

The methodological quality of the randomised controlled trials was assessed by the Jadad scale,[44] which is widely used to classify the quality of evidence from randomised controlled trials. The Jadad scale scores range from 0 to 5. Studies scoring lower than 3 are considered as low quality, and studies that score 3 or more are classified as high quality.[44]

We reviewed the internal validity and risk of bias of trials using RoB 2,[23] a revised Cochrane tool assessing risk of bias arising from five domains in randomised trials: the randomisation process, deviations from the intended interventions, missing outcome data, measurement of the outcome, and selection of the reported result. We assigned each domain a risk of bias (low risk, some concerns, or high risk) based on the domain algorithm, and made an overall judgment (low risk, some concerns or high risk) using the described criteria.[23] The same two reviewers (LCL-J and EB) independently assessed the risk of bias for each included study. Disagreements were resolved by a third reviewer (ETN). To assess non-randomised controlled trials, we used the recently developed tool ROBINS-I.[24] It is particularly useful for systematic reviews that include non-randomised studies of interventions.[24] This tool is guided through seven chronologically arranged bias domains (pre-intervention, at intervention, and post-intervention), and its interpretations of domain level and overall judgment for risk of bias are classified as low, moderate, serious, or critical.[24]

Three independent reviewers (LCL-J, EB, and ETN) assessed the methodological quality of eligible trials. The agreement rate between the reviewers was 94% (κ=0.94) based on Cohen's κ index.

Data synthesis and analysis

According to RoB 2, risk-of-bias judgments for each domain have the following categories: low risk of bias, some concerns, or high risk of bias. Judgments are based on and summarise the answers to signalling questions. RoB 2 also includes algorithms that map responses to signalling questions to a proposed risk-of-bias judgment for each domain.[23] Response options for an overall judgment are the same as those for individual domains. The study can be judged to have (1) a low risk of bias for all domains for this result (low risk of bias), (2) raise some concerns in at least one domain for this result but not to be at high risk of bias for any domain (some concerns), or (3) have a high risk of bias in at least one domain for this result or have some concerns for multiple domains in a manner that substantially reduces confidence in the result (high risk of bias). Overall risk of bias also generally corresponds to the worst risk of bias in any of the domains. However, if a study is judged to have some concerns about risk of bias for multiple domains, it might be judged as having a high risk of bias overall.[23]

The global ROBINS-I judgment was systematised and defined as follows:

- Low risk of bias: the study is comparable to a well performed randomised trial with regards to this domain (the study is judged to have a low risk of bias for all domains)
- Moderate risk of bias: the study is sound for a non-randomised study with regard to this domain but cannot be considered comparable to a well performed randomised trial (the study is judged to have a low or moderate risk of bias for all domains)
- Serious risk of bias: the study has some important problems in this domain (the study is judged to have a low or moderate risk of bias for most domains but is at serious risk of bias in at least one domain)
- Critical risk of bias: the study is too problematic in this domain to provide any useful evidence (the study is judged to have a critical risk of bias in at least one domain)
- No information: no information on which to base a judgment about risk of bias for this domain (information is lacking in one or more key domains of bias for the outcome).[24]

Symptom cluster outcomes measured all three dimensions of symptom occurrence, severity, and distress.[45] The key outcome was measured by considering the extent of symptom clusters experienced by children or adolescents during the hospital stay. Primary outcome measures included the number of children or adolescents with any symptom cluster during their hospital stay and the extent of symptom clusters experienced by children or adolescents as measured by any validated scale for the respective symptoms. Secondary outcome measures were the number of children or adolescents with acute conditions or chronic disorders and the number of children or adolescents satisfied with the care provided.

Most of the studies evaluated showed considerable methodological differences (that is, sample size, data collection scheme, follow-up time points, type of symptom clusters, and severity and onset of the conditions (acute or chronic)). Therefore, the results were too heterogeneous and not suitable for meta-analysis.

Patient and public involvement

Patients were not directly involved in the design and development of this study. As this was a systematic review, no participant recruitment occurred. Dissemination plans to inform the patient community of this study's results include electronic newsletters, press releases, social media, and dissemination through the Companhia do Riso (The Laugh Company) website. Companhia do Riso is a hospital clowning programme led by students and developed and promoted by the University of São Paulo at Ribeirão Preto College of Nursing in a collaborative partnership with the Paediatrics Department of the General Hospital of the Medical School of Ribeirão Preto of University of São Paulo.[30] The programme aims to improve the moods of children and adolescents during their hospital stay and those of their families and staff.[30] These research findings will be useful not only to end users but also to decision makers at the University Hospital (that is, nursing managers and administrative staff). The findings could also affect professional development

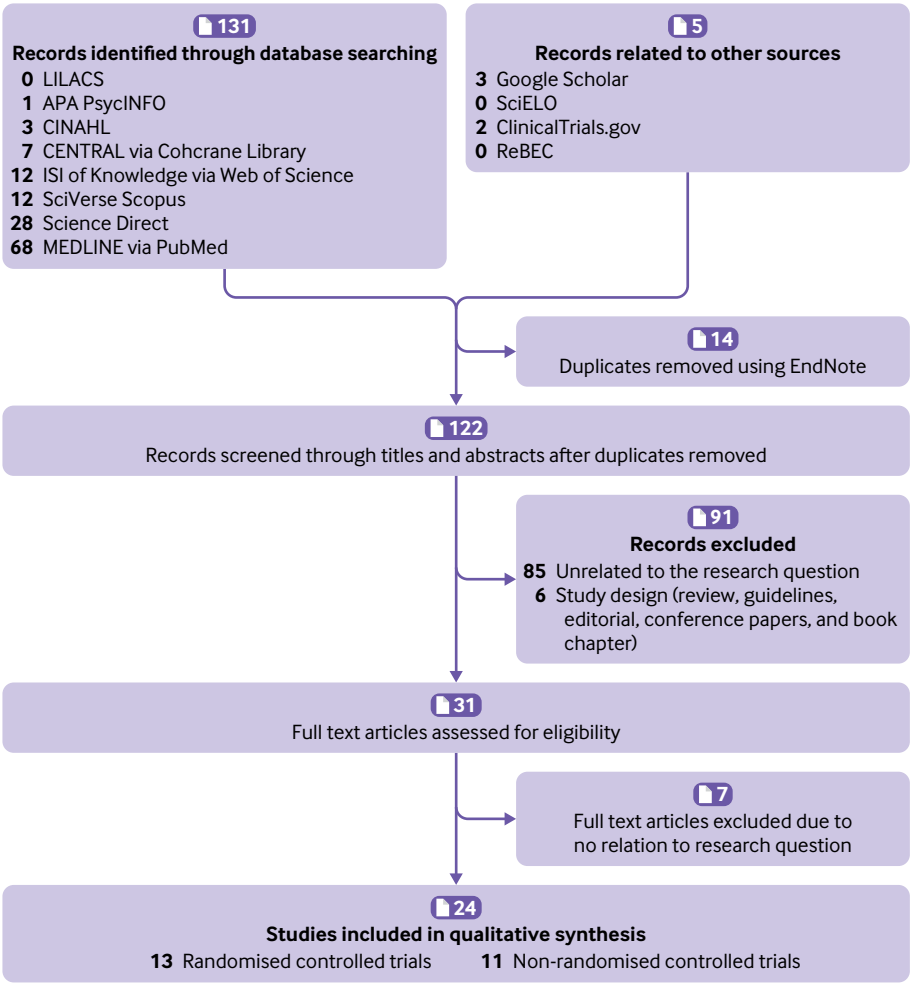

Fig 2 | Flowchart of studies selected according to PRISMA (preferred reporting items for systematic reviews and meta-analyses).[32] Medline=Medical Literature Analysis and Retrieval System Online (via Pubmed); APA PsycINFO=American Psychological Association Psychology Information; LILACS=Latin American and Caribbean Health Sciences Literature; CINAHL=Cumulative Index to Nursing and Allied Health Literature; CENTRAL=Cochrane Central Register of Controlled Trials; ReBEC=Brazilian Registry of Clinical Trials; SciELO=Scientific Electronic Library Online

practices within the paediatric ward, health professionals, and students involved with Companhia do Riso.

Results

Search results

The database search results yielded 131 studies, and we included five additional studies after manual searches in Google Scholar, Scientific Electronic Library Online, clinical trial registries (eg, ClinicalTrials.gov and ReBEC) and in the references of selected primary articles. Endnote screening revealed 14 duplicates. The first screening based on the exclusion criteria excluded most studies (n=91). After eligibility and critical appraisal of the full texts of 31 records, 24 met the inclusion criteria for data extraction and qualitative synthesis (including 1612 children and adolescents). Figure 2 presents an outline of the search process.

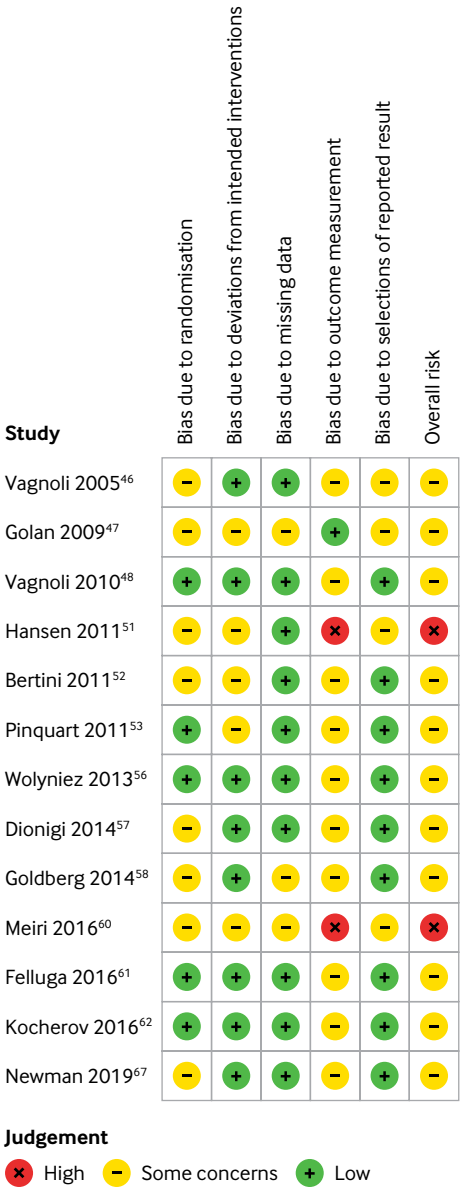

Fig 3 | Internal validity and risk-of-bias assessment of included randomised controlled trials,[46-48 51-53 56-58 60-62 67] according to RoB 2 (revised Cochrane risk-of-bias tool for randomised trials).[23] Plus sign (+) indicates low risk of bias; minus sign (–) indicates some concerns; cross (×) indicates high risk of bias

Characteristics of included studies

Most studies were randomised controlled trials (n=13), and the remaining were non-randomised controlled trials (n=11). Web table 1 summarises the main characteristics of the 24 studies included in the analysis.[46-69] Studies were undertaken in nine different countries, including Italy (n=6),[46 48 52 57 61 64] Israel (n=7),[47 55 56 58 60 62 67] Brazil (n=3),[63 66 69] Portugal (n=2),[50 68] and one study each from Canada,[54] Colombia,[65] Denmark,[51] Germany,[53] South Korea,[59] and Spain.[49] All the studies were single centre trials, and most included male and female patients (n=23).[46-61 63-69] Only one study exclusively included male patients[62] because the study population included children undergoing outpatient penile surgery. Fourteen studies exclusively involved children in hospital (age 2-12),[46-50 52 57 59-64 67] and the 10 remaining studies included both children and adolescents in hospital (age 13-18).[51 53-56 58 65 66 68 69] The mean sample size among studies was 67.16 (standard deviation 57.22, range 6-306).[46-69]

Anxiety was the most analysed symptom (n=13),[46-48 56-62 64 67 68] followed by pain (n=9),[52 56 58-62 67 68] psychological and emotional responses and perceived wellbeing (n=4),[50 53 54 68] stress (n=4),[51 65 66 69] cancer related fatigue (n=3),[66 68 69] and crying (n=2).[51 60] Eight studies assessed anxiety through the modified Yale Preoperative Anxiety Scale.[46-48 55-59 62 64] Only three studies used a biomarker (salivary cortisol) to assess stress outcome.[63 65 67] Two recent studies used a panel of biomarkers to assess psychological stress and cancer related fatigue, including cortisol, α amylase, pro-inflammatory cytokines, anti-inflammatory cytokines, and matrix metalloproteinases.[66 69]

Of 13 randomised controlled trials, only four[52 53 56 61] showed high methodological quality according to the Jadad scale (score 3), whereas the remaining nine randomised controlled trials[46-48 51 57 58 60 62 67] had Jadad scores of 1 or 2, indicating low methodological quality. Regarding the revised RoB 2, most of the randomised controlled trials[46-48 52 53 56-58 61 62 67] (n=11; 85%) were rated as having some concerns, and only two[51 60] were rated as having a high risk of bias (fig 3 and fig 4). Only five randomised controlled trials[48 52 53 61 62] (n=5; 38%) were rated as having a low risk of bias arising from the randomisation process, whereas the remaining randomised controlled trials[46 47 51 52 57 58 60 67] (n=8; 62%) were rated as having some concerns for this domain. Most randomised controlled trials (n=9; 69%)[48 52 53 56-58 61 62 67] had a low risk of bias in the selection of the reported result.

Of 11 non-randomised controlled trials, only one was rated with a low risk of bias in all domains,[66] six[50 59 64 65 68 69] showed moderate risk of bias according to ROBINS-I, and four[49 54 55 63] showed serious risk according to ROBINS-I classification owing to the presence of serious risk of bias in at least one domain

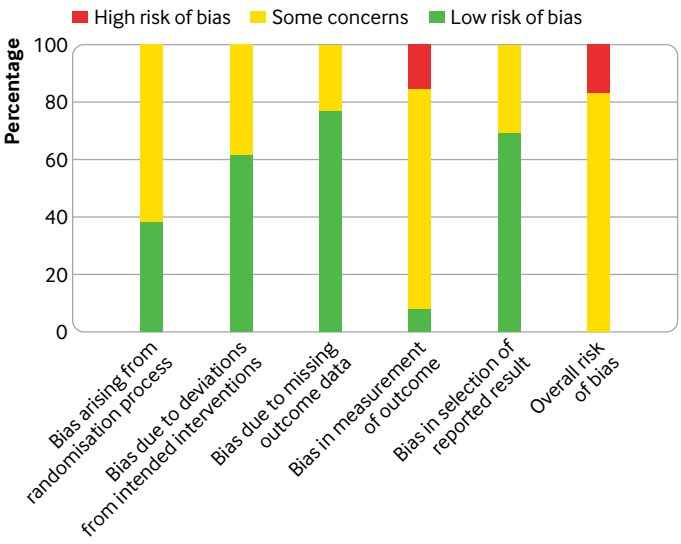

Fig 4 | Percentage of risk of bias among included randomised controlled trials,[46-48 51-53 56-58 60-62 67] by domains of RoB 2 (revised Cochrane risk-of-bias tool for randomised trials)[23]

(although they were at low or moderate risk of bias for most domains; table 1). In general, regarding the risk of bias assessment for non-randomised controlled trials, the main causes of serious overall bias risk according to ROBINS-I were weaknesses in the confounding bias domains, selection of participants, and outcome measurement biases.

Hospital clowns for symptom cluster management in children and adolescents in hospital

Twelve studies[46-48 56-62 64 67] showed that children and adolescents who received hospital clowns either with or without a parent present at the moment of the intervention reported significantly less anxiety and better psychological adjustment or showed a reduced increase in anxiety scores in the preoperative room before painful procedures and during the induction of anaesthesia compared with those in control groups with standard care. One study showed that children who interacted with hospital clowns reported significantlyfewer worries and an increased positive affect in the preoperative room compared with the control group.[50] Another article[52] described improved clinical evolution of children with respiratory pathologies who interacted with hospital clowns. Respiratory symptoms disappeared earlier in these patients who also had significantly reduced diastolic blood pressure, respiratory frequency, and tempera ture compared with the control group. In four studies[63 65 66 69] of children and adolescents in hospital with different pathologies, researchers reported reduced levels of salivary cortisol after hospital clowns compared with the pre-intervention measurement. However, another study showed that intraoperative serum cortisol levels of children in the clown group increased significantly compared with the control group (P<0.001).[67]

The presence of a medical clown during a painful procedure in the paediatric emergency department tended to improve pain scores in children younger than 7.[56] Additionally, children undergoing day surgery for strabismus who received hospital clowns had less pain after surgery (P<0.001) than the control group.[59] Furthermore, one study[55] that examined the role of medical clowns during anogenital examination and their influence in psychological distress reported less pain (P<0.05) and reduced fear (P<0.001) in children and adolescents compared with the control group receiving standard care as assessed by the post-traumatic stress disorder symptoms scale (PSS-I).

Two studies[51 60] described a significantly shorter crying period when clowns were present. Three other studies[47 53 54] reported that children and adolescents in hospital who interacted with hospital clowns had an increase in self-reported psychological wellbeing as well as an improvement in emotional responses compared with those in control group. In contrast, one study[49] found that hospital clowns were not able to reduce the child's level of distress with no statistically significant decrease in postoperative maladaptive behaviours in the experimental group compared with the control group.

Discussion

Principal findings

In this systematic review, we identified and critically examined evidence from randomised controlled trials and non-randomised controlled trials on the effectiveness of hospital clowns for symptom cluster management in children and adolescents admitted to hospital with both acute and chronic conditions. Overall, our findings suggest that hospital clowns might have a positive effect in improving psychological wellbeing and emotional responses in children and adolescents in hospital with acute as well as chronic disorders. To the best of our knowledge, this is the first systematic review of randomised controlled trials and non-randomised controlled trials on the effectiveness of hospital clowns for symptom management in paediatric inpatients that took into account acute and chronic conditions and symptom clusters or burden during hospital stay and that used suitable tools for critical appraisal of risk of bias.

Although randomised controlled trials predominated in our review (n=13), a considerable number of non-randomised controlled trials (n=11) also met all inclusion criteria and were analysed. Well conducted randomised controlled trials remain the gold standard for assessing interventions given that their design controls for both measured and unmeasured confounding variables. This explains why systematic reviews with meta-analyses of randomised controlled trials are well accepted by clinicians and decision makers.[70 71] However, non-randomised controlled trials have increased exponentially in recent years, and these studies have large sample sizes, long follow-

Table 1 | Consensus ROBINS-I judgments between two reviewers by domain of bias

	ROBINS-I* domains							
Study	Bias due to confounding	Bias in selection of participants	Bias in measurement of interventions	Bias due to departures from intended interventions	Bias due to missing data	Bias in measurement of outcomes	Bias in selection of reports results	Overall ROBINS-I judgment*
Meisel et al 2010[49]	Moderate	Moderate	Moderate	Moderate	Low	Serious	Low	Serious
Fernandes et al 2010[50]	Moderate	Moderate	Low	Low	Low	Moderate	Low	Moderate
Kingsnorth et al 2011[54]	Moderate	Moderate	Moderate	Serious	Low	Moderate	Low	Serious
Tener et al 2012[55]	Serious	Moderate	Moderate	Moderate	Low	Moderate	Low	Serious
Yun et al 2015[59]	Low	Moderate	Low	Low	Low	Low	Low	Moderate
Saliba et al 2016[63]	Moderate	Serious	Low	Low	Low	Serious	Low	Serious
Dionigi et al 2017[64]	Moderate	Moderate	Low	Low	Low	Low	Low	Moderate
Sánchez et al 2017[65]	Moderate	Moderate	Low	Low	Low	Moderate	Low	Moderate
Lopes-Júnior et al 2018[66]	Low	Low	Low	Low	Low	Low	Low	Low
Arriaga et al 2020[68]	Low	Moderate	Low	Low	Low	Low	Low	Moderate
Lopes-Júnior et al 2020[69]	Low	Moderate	Low	Low	Low	Low	Low	Moderate

ROBINS-I=risk of bias in non-randomised studies.[24]
*Overall judgment includes the following categories: low risk of bias (the study is comparable to a well performed randomised trial with regard to this domain (the study is judged to have a low risk of bias for all domains)); moderate risk of bias (the study is sound for a non-randomised study with regard to this domain but cannot be considered comparable to a well performed randomised trial (the study is judged to have a low or moderate risk of bias for all domains)); serious risk of bias (the study has some important problems in this domain (the study is judged to have a low or moderate risk of bias for most domains but is at serious risk of bias in at least one domain)); critical risk of bias (the study is too problematic in this domain to provide any useful evidence (the study is judged to have a critical risk of bias in at least one domain)); no information (no information on which to base a judgment about risk of bias for this domain (there is a lack of information in one or more key domains of bias for the outcome)).[24]

up periods, and advances in analytical approaches to control for confounding bias.[72 73] Although non-randomised controlled trials provide different information from randomised controlled trials,[74] these methods can complement each other, and systematic reviews of both trial types are needed to provide a comprehensive assessment of a body of evidence.[75 76]

Identifying and categorising the severity of domain specific flaws to assess the overall quality of non-randomised controlled trials requires the use of suitable instruments,[24 76] such as ROBINS-I, a tool developed for use in systematic reviews that include non-randomised controlled trials to assess risk of bias in these studies.[24] In our review, most studies (n=6)[50 59 64 65 68 69] were rated as the moderate category according to the ROBINS-I bias risk, and four[49 54 55 63] were classified in the serious category. These findings are consistent with a recent study that assessed the reliability and usability of a new Cochrane risk-of-bias tool for non-randomised controlled trials of interventions, which found that most studies were rated as having a moderate or serious risk of bias.[76] In this study, the main causes of serious overall assessments were weaknesses in the confounding variables and selection of participant domains.

Comparison with other studies

Our results indicate that the involvement of clowns during medical procedures reduce fear, pain, and symptoms of invasiveness. These results are consistent with previous reviews[18 21 22] and with other studies in which the presence of a medical clown during invasive medical examinations reduced both children's and parents' symptoms of distress[46 77 78] as well as children's levels of physical pain.[79] In addition, the presence of a medical clown helped the practitioners in conducting the examination and decreased distress in children and adolescents, consequently increasing their cooperation with the medical procedure.[46 48 54 80-82]

The groups receiving the hospital clown intervention also experienced significantly lower anxiety as well as better psychological adjustment (especially in the preoperative room and during the induction of anaesthesia) than control groups receiving standard care. This finding is consistent with previous research showing that the presence of a medical clown contributes to reduced anxiety levels and distress related to minor surgery in the preoperative room.[47 78 82-84] In addition, other studies have noted a positive influence of medical clowns on children's emotional state and psychological wellbeing.[68 85-87]

The impact of hospital clowns during surgery and intensive care has been most frequently studied in paediatric samples. Studies in these conditions have shown promising findings, such as a decrease in the negative impact of hospital stay and surgery experiences, primarily reducing anxiety not only of children and adolescents but also of caregivers.[46 50 57 84 88] These findings have also been highlighted in three meta-analyses based on randomised controlled trials.[18 21 22] Other empirical studies have evaluated the effect of hospital clowns during the use of invasive medical procedures and potentially anxiety provoking procedures, such as skin allergy tests,[58] venipuncture,[89] intravenous catheter insertion,[56] injections of botulinum toxin,[51 90] or recurrent hospital stays requiring repeated painful procedures.[91] Overall, these studies also suggest that hospital clown interventions are valuable in relieving the pain and emotional distress in children undergoing painful and stressful procedures. A meta-analysis focusing on the broader effects of hospital clowns in patients undergoing potentially anxiety inducing procedures has also reported their effectiveness on children's anxiety during medical procedures.[22]

Despite the favourable results of hospital clown intervention in paediatric populations with multiple conditions, less research has been conducted on disorders such as cancer. To our knowledge, few studies

have been conducted in this area so far, including two reported in conference proceedings,[92 93] one pilot study,[66] and four other original studies.[63 65 67 69] One conference proceeding[92] indicated that hospital clowns reduced fatigue in patients aged 7-18 undergoing chemotherapy, whereas another study[93] found no effects from the presence of hospital clowns on distress among patients aged 3-18. The pilot study[66] reported reduced overall trends for cortisol levels over time for all six paediatric patients with osteosarcoma included in the study. In addition, a similar pattern of levels in tumour necrosis factor α were noted over time for all patients. Patients with metastatic osteosarcoma showed a linear trend for reduced levels of matrix metalloproteinase 9 between 1 and 9 hours after hospital clown intervention and restoration to basal levels after 13 hours.

Two original studies[63 65] reported reduced levels of salivary cortisol after intervention with hospital clowns compared with the pre-intervention measurement. Another study[67] suggested that compared with the control group, patients receiving the hospital clown visit during chemotherapy reported increased calmness and happiness (P<0.05), as well as reduced fatigue (P<0.05), pain (P=0.004), and distress (P=0.034); however, significantly increased levels of serum cortisol were observed in the clown treatment group. Finally, the most recent study[69] evaluated the effect of clown intervention on the levels of psychological stress and cancer related fatigue in paediatric patients with cancer undergoing chemotherapy. Researchers found that total levels of psychological stress and cancer related fatigue improved after the clown intervention compared with baseline (P=0.003 and P=0.04, respectively). This same study reported a significant decrease in salivary cortisol after clown intervention at the collection time points of +1, +9, and +13 hours (P<0.05); however, α amylase levels remained unchanged.[69]

Overall, paediatric outpatients in chemotherapy reported low levels of negative physical symptoms and negative feelings,[66 68 69] which are consistent with studies demonstrating that most patients adapt well to cancer treatment.[94 95] Additionally, these results are consistent with studies that examined the effects of hospital clowns with other samples of paediatric patients with different clinical conditions.[18 20-22]

However, treatment related symptoms and negative feelings in paediatric patients remain important in clinical practice, leading to difficulties in adjusting to cancer diagnosis and treatment, which might cause a reduction on patients' therapeutic adherence and recovery process.[12 66 68 69 96-98] Because mainstream practices do not seem to holistically tackle these problems, complementary non-pharmacological practices have been suggested.[4 99-101]

Composition, consistency, and stability of symptom clusters vary widely depending on various measurement factors, including the optimal assessment tool (long *v* short), most clinically relevant symptom dimensions (prevalence *v* severity or distress caused), optimal analytical method to derive the cluster, optimal statistical cut-off points to define symptom clusters, and optimal timing of assessment.[11 45]

Furthermore, previous works have reported a positive relation between caregivers' anxiety and children's distress experienced during medical procedures.[50 102 103] Longitudinal data have also shown a moderate to strong equivalency between the caregiver's and the child's experiences on emotional competence during treatment.[104]

A systematic review has reported that participants' age was an important factor in studies on treatment adherence.[105] However, further studies are warranted to unveil age's role in oncological treatment adherence. While children tend to easily show their emotional distress,[106] adolescents are prone to conceal their feelings and might show more behavioural control.[107] Therefore, self-reported questionnaires might not be advantageous to adolescents as much as to older research, who tend to express their feelings and symptoms with higher validity through these tools.[68]

One of the non-randomised controlled trials reviewed[49] however, one trial revealed no influence of interaction with clowns on children's distress. This inconsistency could be due to methodological reasons. Firstly, psychological distress was measured through the facial affective scale, which might have been insufficiently sensitive and reliable for measuring distress in the youngest children. Secondly, the interaction with the hospital clowns in this study lasted for only seven minutes, which is possibly not long enough to secure involvement of the youngest children. Furthermore, this study had serious bias in the measurement outcomes domain according to ROBINS-I, given that the researchers who applies the facial affective scale were not blind to the conditions of the study (although the other six ROBINS-I domains were assessed as low or moderate risk of bias).

The role of the hospital clowns is to provide humour, laughter, and play for the benefit of the patients, their parents, and even the staff.[14] Additionally, a nationwide survey of clowns, parents and support staff in hospitals in Germany concluded that hospital clowns boost morale and reduce stress in patients without any side effects.[108] Moreover, some evidence have indicated the effects of hospital clowns on reducing distress in parents and health professionals as well.[108-110] By offering moments of recreation, most researchers perceived hospital clowns as additional opportunities to restore energies.[30 69 109]

Coulrophobia (the fear of clowns) was first reported in the 1980s. Despite being a well defined phobia, only a few studies have aimed to determine its prevalence or understand its meaning in the general population. Similarly, the phobia has been scarcely studied in patients with cancer. However, previous studies have indicated that although hospital clowns have become widely popular, some children are terrified by hospital clowns.[111] Adults have also reported to finding clowns scary and distressing.[111] A study even found that of 14 paediatric clinicians, four considered themselves

to be afraid of clowns.[112] A study in England reported that most children (82%) who participated in a clown intervention enjoyed the performances, and only three (6%) disliked it.[113] Another study in Germany found that about 1% of the population reported having a fear of clowns.[114]

A recent cross sectional study aimed to examine the prevalence of coulrophobia in 1160 children in hospital. The study reported a prevalence of coulrophobia of 1.2%, with a significant prevalence in female patients (85.7%).[111] The authors also showed that children who felt severe coulrophobia also reported fear of encountering or thinking about a hospital clown interaction.[111] This study reported the median age of children experiencing fear of clowns, which was 3.5 years. General fear and anxiety (eg, fear of strangers) is experienced around age 8 months to 1.5 years. Therefore, the finding that many of the children reporting fear of clowns were younger is not surprising.[111] Further large scale studies are warranted to better comprehend this distinctive phenomenon of coulrophobia in paediatric patients.

Strengths and limitations of the study

Most of the studies included in this review were conducted with children and adolescents with acute diagnoses; the few that evaluated chronic conditions took into account a set of acute diagnoses together, increasing the bias in these studies. We suggest that this factor can be better investigated separately to identify which patient profiles can benefit the most from this type of intervention. When evaluated methodologically by RoB 2, most randomised controlled trials rated as having some concerns for overall risk of bias (n=11; 85%), leading to questions about the reliability of the results and thus compromising the external validity of the results.

Another limitation was the heterogeneity of the studies regarding the data collection scheme, follow-up time points, participant grouping, heterogeneity of symptom clusters, and severity and onset of the conditions (acute or chronic). For this reason, quantitative assessments were not feasible. Therefore, we suggest that new randomised controlled trials should be conducted with a longer follow-up to detect whether the effects of using hospital clowns for acute or chronic conditions in paediatric patients are sustained in the short and medium term to long term. Thus, more randomised controlled trials are needed with representative samples of the population and low risk for bias.

Despite these limitations, this review looks at important gaps in the literature, because we have gathered and critically evaluated a vast body of evidence from randomised and non-randomised controlled trials on the effectiveness of hospital clowns on symptom clusters in paediatric patients. Our findings also support the continued investigation of complementary treatments for better psychological adjustment during the hospital admission process in paediatrics.

As clinicians strive to minimise the psychological burden during the hospital admission process, they should be aware of the scientific evidence available to help them incorporate appropriate laughter and play into clinical practice.[14] Children and adolescents who need to stay in hospital represent a special challenge for the healthcare system and health professionals, owing to the illness itself and the treatment process.[110 115] In addition, these children and adolescents with acute or chronic disorders are also stressed by the separation from their parents, the hospital environment, the fear of painful treatments, and the uncertainty of the treatment outcome.[13 50]

Conclusion and study implications

Our results indicate that interaction with hospital clowns during medical procedures, induction of anaesthesia, and as part of routine care for chronic conditions could be a valuable strategy to manage some symptom clusters. Furthermore, hospital clowns might contribute to the improvement of psychological wellbeing and emotional responses in children and adolescents in hospital with acute and chronic disorders compared with those receiving standard care. Hospital clowns are a subjective intervention, but researchers in the psychoneuroimmunology and biobehavioural field have begun to look at this intervention beyond subjective constructs—that is, changes in the profile of endocrine and immunological biomarkers. However, only a few studies have looked at endocrine and immunological biomarkers so far because this approach remains in its infancy. Further research is warranted to assess the impact of hospital clowns in symptom clusters in long term hospital stay and to establish correlations with clinical outcomes and biomarkers. Future studies will help to elucidate the mechanisms underlying the effect of this intervention.

Another question would be whether a child life specialist wearing a friendly looking non-clown costume would lead to the same or better effects than hospital clowns. It is also important to consider the satisfaction of parents or formal and informal caregivers who accompany paediatric patients and whether the same hospital clown intervention has any impact on their anxiety, fatigue, stress levels, and other symptoms. Future studies are encouraged to investigate potential coulrophobia in paediatric patients. Moreover, a more comprehensive evaluation of the effect of hospital clowns in children and adolescents in hospital can be attained via the use of larger sample sizes with well performed randomised controlled trials and considering specific populations separately, such as patients with cancer or with other chronic conditions.

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The lead authors (LCL-J, EB) affirm that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Dissemination to participants and related patient and public communities: Patients were not directly involved in the design and development of this study. As this is a systematic review, no participant recruitment occurred. Dissemination plans to inform the patient community of this study's results will be via electronic newsletter, press release, social media, and dissemination through the Companhia do Riso (The Laugh Company) website. Companhia do Riso is a student led programme of hospital clowning, developed and promoted by the University of São Paulo, Brazil, at Ribeirão Preto College of Nursing in a collaborative partnership with the paediatrics department of the General Hospital of the Medical School of Ribeirão Preto of University of São Paulo (HCFMRP-USP).[30] The programme aims to improve the moods of children and adolescents during their hospital stay and those of their families and staff.[30] These research findings will be useful not only to end users but also to decision makers (nursing managers and administrative staff) at the university hospital. The findings could also affect professional development practices within the paediatric ward, health professionals, and students involved with Companhia do Riso.

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Web table 1: Summary of 24 selected articles