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The effect of web-based preoperative information on parents of children who are going through elective ambulatory surgery: A systematic review and meta-analysis

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ABSTRACT

Objective: To evaluate the effect of preoperative web-based information to parents of children undergoing elective ambulatory surgery performed with anesthesia. Outcome measures were parental anxiety, knowledge, and satisfaction.

Method: The review followed the PRISMA statement. A systematic search of six databases was conducted. Randomized controlled trials, cluster-randomized trials and quasi-randomized controlled trials were eligible for inclusion.

Result: Eight studies were included. An effect in favour of web-based information compared to standard information was observed for parental anxiety measured before separation from child (SMD=−0.66, 95% CI=−0.92 to −0.40) and after surgery (SMD=−0.55, 95% CI=−0.95 to −0.16), for parental knowledge measured in-hospital (SMD=1.10, Cl 95%=0.37–1.82), and parental satisfaction after discharge (SMD=1.03, 95% Cl=0.41–1.65). No effect was observed for anxiety at separation, and for satisfaction in-hospital. The certainty of the evidence varied from very low to moderate.

Conclusion: Depending on the timing of assessment, web-based information before pediatric surgery may reduce the level of parental anxiety and increase the level of parental knowledge and satisfaction more than standard care.

Practice implications: Web-based routines can be used to convey pre-operative information to parents before paediatric ambulatory surgery. Still, standardized research that enables further comparison across studies is needed.

1. Introduction

The growth of ambulatory surgery has been exponential the last few decades due to developments in anesthesia and improvements in surgical techniques [1]. In ambulatory surgery, admission to and discharge from the surgery unit to home happens on the same day as the surgery [2]. In 2014, the American Hospital Association reported that about 66% of all surgeries at community hospitals in the United States were performed as ambulatory surgeries [3]. The Association of Anesthetists in Great Britain and Ireland have estimated that at least 90% of surgery in children could be performed as ambulatory surgery [4].

In an ambulatory setting parents are responsible for their child's care before and after surgery [2,5]. Opportunities for direct communication are limited, and health professionals rely on parents to have received sufficient information, understand how to prepare their child prior to surgery, provide post operative care after surgery, administer medication, and observe potential complications following discharge [2]. Parental anxiety may cause anxiety in children, and levels of anxiety may be reduced by preoperative information [6]. International guidelines [2,4,5] emphasize the importance of preoperative education to children and parents, and healthcare institutions increasingly publish web-based preoperative information on their websites [7].

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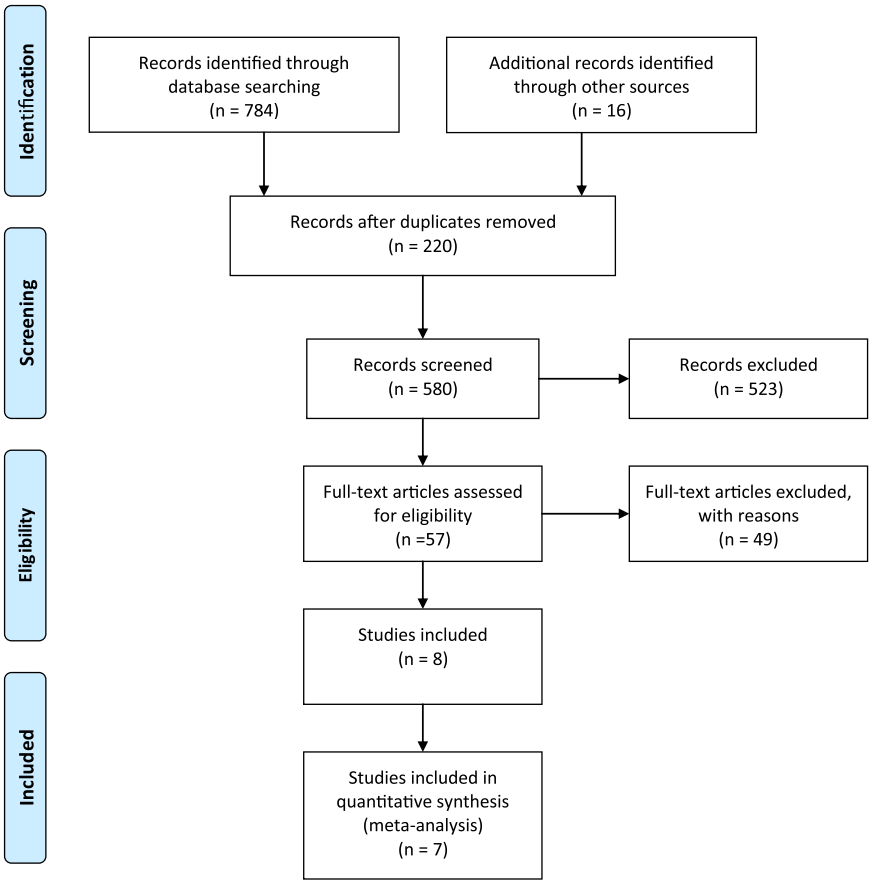

Fig. 1. PRISMA flow diagram.

The provision of information via web-access offers the possibility to combine audiovisual components like text, picture, sound, and video online. The information can be accessed from various electronic devices at a time and place suitable for the reader. Previous reviews have assessed the effect of various technology assisted patient health education interventions on outcome measures among children and adult patients. These interventions comprised web-based [8], internet and interactive computer-based programs [9,10], mobile applications [11], telemedicine [12], audiovisual interventions [13,14] and internet-based resources [7]. None of the reviews specifically examined web-based interventions targeting parents, and only Chow et al. [13] reported on parental outcomes. To our knowledge, no review has systematically examined the effect of web-based preoperative information on parental anxiety, knowledge, and satisfaction.

The aim of this systematic review was to evaluate the effect of web-based preoperative information to parents of children undergoing elective ambulatory surgery performed with anesthesia. The primary objectives underpinning this review were to assess the effect of web-based preoperative information on parental anxiety before, under or after their child`s surgery, parental knowledge about the operation and how to support the child, and parental satisfaction with the preoperative information. Secondary objectives were to evaluate the impact of when parents were given access to the information, and of the number of times that parents read the information.

2. Methods

The review followed the PRISMA statement (Preferred Reporting Items for Systematics reviews and Meta-analyses) [15]. A protocol is registered in PROSPERO (record number CRD42019119960) [16].

2.1. Study inclusion criteria

Randomized controlled trials, cluster-randomized trials, and quasi-randomized controlled trials were considered for inclusion.

Participants were parents, caregivers, or other persons assuming the parental role, with children (0–18 years) undergoing elective ambulatory surgery. In the following, parents will also denote caregivers and other persons assuming the parental role. To be considered for inclusion, the ambulatory surgery should be performed in general anesthesia at a hospital, a physician's office, or a surgical center with discharge the same day or the next morning, depending on whether late surgery resulted in a delayed fulfillment of discharge criteria.

The web-based preoperative information could be designed for children and parents jointly, or for parents only. The information had to be given before initiation of anesthesia and include some or all the following elements: text, sound, graphics, animations and/or film/video. The information could be communicated on different devices, such as PCs, tablets, or mobile phones, or the website could have a responsive design fitting all these devices. Also, the information could be communicated through downloaded data applications, be interactive or generate answers to questions written by reader (chatbot's). Studies were excluded if the intervention did not include use of a stated web page or website that addressed specific preoperative information.

The comparators were any none web-based routines for conveying standard preoperative information, including written or oral information given by health personnel to parents, either with or without the child.

The outcome measures were parental level of anxiety before, under or after the surgical treatment of the child, parental level of knowledge about the operation and/or how to support the child in the pre- and postoperative period, and parental level of satisfaction with the

Table 1
Study characteristics.

Author, year Country	Recipient information (number of)	Modality of experimental web-based preoperative information	Comparator preoperative information	Access to web-based information	Intervention details	Included parental outcome (s)
Bailey et al., 2015 Canada	Parents (n = 93)	Video application (app) on iPad	Three slides on iPad (standard preoperative information)	Same day at hospital	*Experimental:* Information about anesthesia induction, parent`s possibility to be present at anesthesia induction, parental emotion, and how to support the child. *Comparator:* Information about what to wear and where to sit in operating room	Anxiety
Fernandes et al., 2015 Portugal	Parents (n = 60) and children	Educational multimedia application with interactive game activities	1) Standard care 2) Entertainment video game	Same day at hospital	*Experimental:* A brief introductory explanation and exercise: how to report emotions, illustrating hospital procedures and stages, parental separation, induction to anesthesia, after care, and going home. *Comparator:* Standard care or child playing popular video game	Anxiety
Fortier et al., 2015 USA	Parents (n = 82) and children	"WebTIPS"	Standard care	Seven days before and until seven days after surgery	*Experimental:* Web TIPS web site included information about pain management attitudes, preferences for sedative, premedication, and parental presence during induction of anesthesia. *Comparator:* Standard care as provided in the institution	Anxiety
Huntington et al., 2017 United Kingdom	Parents (n = 119) and children	Interactive web domain and an accompanying pamphlet to direct use	1) Standard care 2) Placebo video game	Seven days before	*Experimental:* Information designed to complement the standard care. Intervention with 22 screens, a cartoon story and two videos which model appropriate behaviour and teach coping skills. An accompanying pamphlet directed parents about how to use it with their child. *Comparator:* Standard care including instruction of fasting and wound care and a coloring book about healthy food choices, or placebo video game about handwashing	Satisfaction
Ji et al., 2016 China	Parents (n = 102)	drawMD APP aiding verbal information	Standard preoperative verbal information	Day before	*Experimental:* Verbal information aided by the drawMD APP; a personalized drawing for the patient with sketching tools, text annotations and condition, or procedure-specific stamps. *Comparator:* Verbal information only	Anxiety, Satisfaction
Liu et al., 2018 China	Parents (n = 418) and children	WeChat educational module	Leaflet	Days before	*Experimental:* Information on pediatric inguinal hernia, pre-operative preparation for children, and postoperative information about complications to observe at home. Parents could read and send messages to WeChat nurse manager for concerns after the preoperative consultation. *Comparator:* Leaflet with same educational information, and same ability to contact day surgery as experimental group	Knowledge
Lööf et al., 2017 Sweden	Parents (n = 115) and children	Anaesthesia-Web	Brochure	Days before	*Experimental:* Structured oral information and encouragement to visit the Anaesthesia-Web (https://www.anaesthesiaweb.org/en/). *Comparator:* Structured oral information and encouragement to read brochure	Knowledge
O`Conner -Von, 2008 USA	Parents (n = 70) and adolescent	Internet preparation program	Standard hospital preparation program	Days before	*Experimental:* Information of routines during outpatient surgery, photographs, and explanation of medical equipment and personal involved in the surgical experience, and advice for home care after surgery. *Comparator:* An evening information meeting where health personal presented photographs and medical equipment	Anxiety, Satisfaction

preoperative information.

2.2. Data searches and selection

The search was performed in the following databases: MEDLINE Ovid (1946 - October 2020), EMBASE Ovid (1974 - October 2020), The Cochrane Central Register of Controlled Trials CENTRAL (to October 2020), CINAHL EBSCO (1981 - October 2020), PsycINFO Ovid (1987 - October 2020), and SveMed+ (1977 - October 2020). Web of Science was searched for citations. Open Grey was searched for unpublished literature, and "International Clinical Trials Registry Platform Search Portal WHO-ICTRP", and "ClinicalTrials.gov" for unpublished, registered trials (October 2020). The reference lists of included studies were screened for additional references. There were no limitations on language or year published. The searches were performed in August 2018 and re-run in October 2020. The PICO (Participants, Interventions, Comparisons, Outcomes) framework was employed to develop the search strategy [17]. Search terms were related to population and intervention and included *ambulatory surgery*, *child*, *parent*, *patient education*, *multimedia, internet* and *web-based.* The complete search strategies

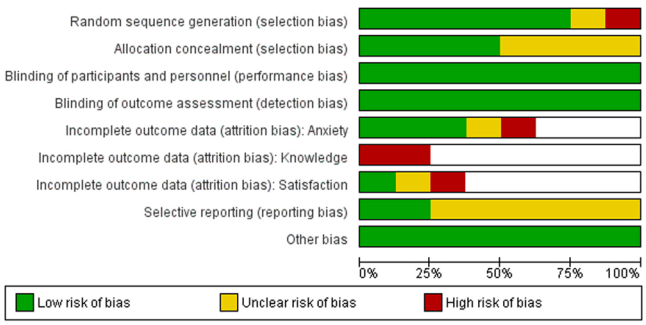

Fig. 2. Risk of bias graph.

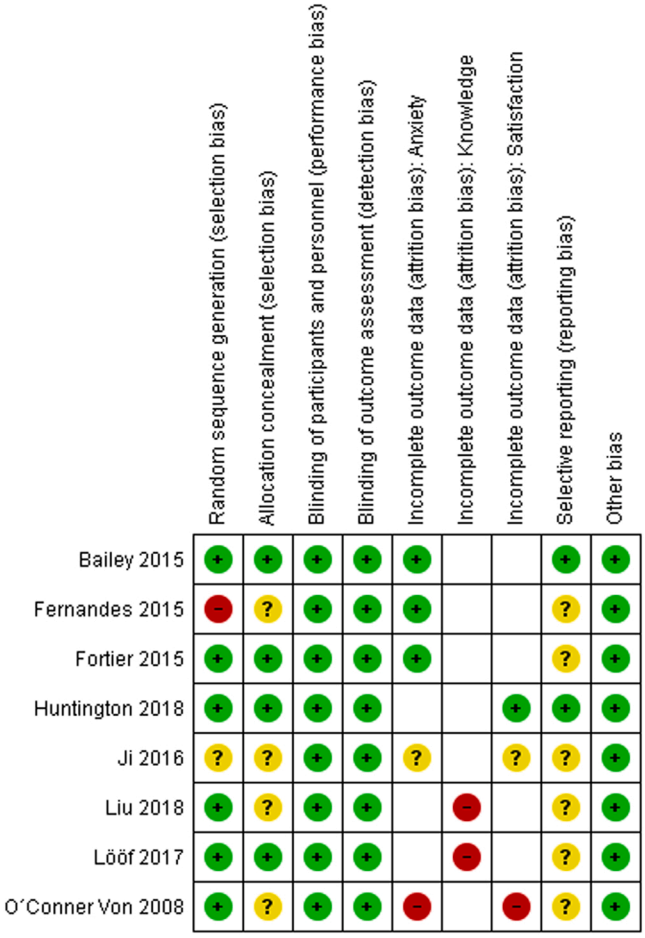

Fig. 3. Risk of bias summary.

are reported in Appendix A.

Two researchers (KLN and IOM) independently screened titles, abstracts, and full text articles for inclusion, using Covidence systematic review management [18]. Any disagreement was resolved by consensus and, if necessary, consultation with a third researcher (AKS or BE).

2.3. Quality assessment

The Cochrane tool for assessing risk of bias [19] was utilized to assess the methodological quality of included studies. The tool covers sequence generation, allocation concealment, blinding, incomplete outcome data, selective outcome reporting and other biases. Two researchers (KLN and IOM) independently evaluated risk of bias (RoB). Any disagreement was resolved by consensus and, if necessary, consultation with a third researcher (AKS or BE).

2.4. Data extraction and analysis

Two researchers (KLN and IOM) independently extracted data, applying a modified "Checklist of items to consider in data collection or data extraction" [20]. When data were missing, authors were contacted for information.

The software Review Manager 5.4 (RevMan) [21].and the "meta" package [22] in R [23], was used for statistical analyses. As outcomes were measured using different numerical scales, the standardized mean difference (SMD) was used to estimate intervention effects [24]. When outcomes were reported with median mean values, these were used in the analyses. Additionally, if variation in measurements were reported as interquartile ranges, the standard deviation (SD) was calculated as the interquartile range divided by 1.35, assuming large sample sizes and a symmetric data distribution [24]. Further, odds ratios were re-expressed as SMD [25]. The "generic inverse variance method" [26] was used to enter effect estimates and their standard errors directly when group specific results were not applicable. Individual study results were summarized using a random-effects meta-analysis [26] to incorporate unexplained heterogeneity in study results. A three-level meta-analysis model was used if more than one estimate came from the same study [27]. Meta-analyses were based on post-intervention measures, except for studies reporting baseline group differences where we applied change scores. In these cases, we applied SD measures reported after the intervention [26].

Heterogeneity in study results was quantified by the I^2 statistics [26]. We planned a sensitivity analysis if the I^2 was larger than 50%. If meta-analysis was not applicable due to substantial heterogeneity combined with variation in the direction of the effect [26], a narrative synthesis of findings was performed.

According to protocol, we planned to conduct subgroup analyses to evaluate the impact of the timing of accessing the information, and of the number of times that parents read the information.

The Grading of Recommendations Assessment, Development and Evaluation (GRADE) [28] was applied to draw conclusions about the quality of the evidence in this systematic review.

3. Results

3.1. Search results

The database search generated 784 records, and an additional 16 records were identified from other sources (Fig. 1). After removing 220 duplicates, title and abstract were screened for the remaining 580 records. As a result, 57 full-text articles were assessed for eligibility, of which eight studies met the inclusion criteria. We excluded 49 studies with documented reasons (Appendix B).

The total number of parents to children undergoing elective ambulatory surgery was 1059, with a range of 60–418 participants in the included studies (Table 1, Appendix C). Mean age of the children ranged from 2.6 to 11.5 years. All studies were randomized controlled trials published between 2008 and 2018.

The web-based interventions covered preoperative information concerning induction to general anesthesia, operative treatment, preparation of parents for parental role, and how to support and take care of the child before and after surgery. The interventions were dedicated to parents only [29,30], or to both children and parents [31–36] (Table 1, Appendix C). Three studies included interventions with interactive activities [29,31,34], while in five studies the intervention was without interactivity [30,32,33,35,36]. The interventions were piloted in five of the eight studies [31,32,34–36]. The delivery of the intervention varied, with information being accessible at the hospital the day of surgery [30, 34] or the day before surgery [29] or at home for one [33] or more days prior to surgery [31,32,35,36]. Two studies included communication

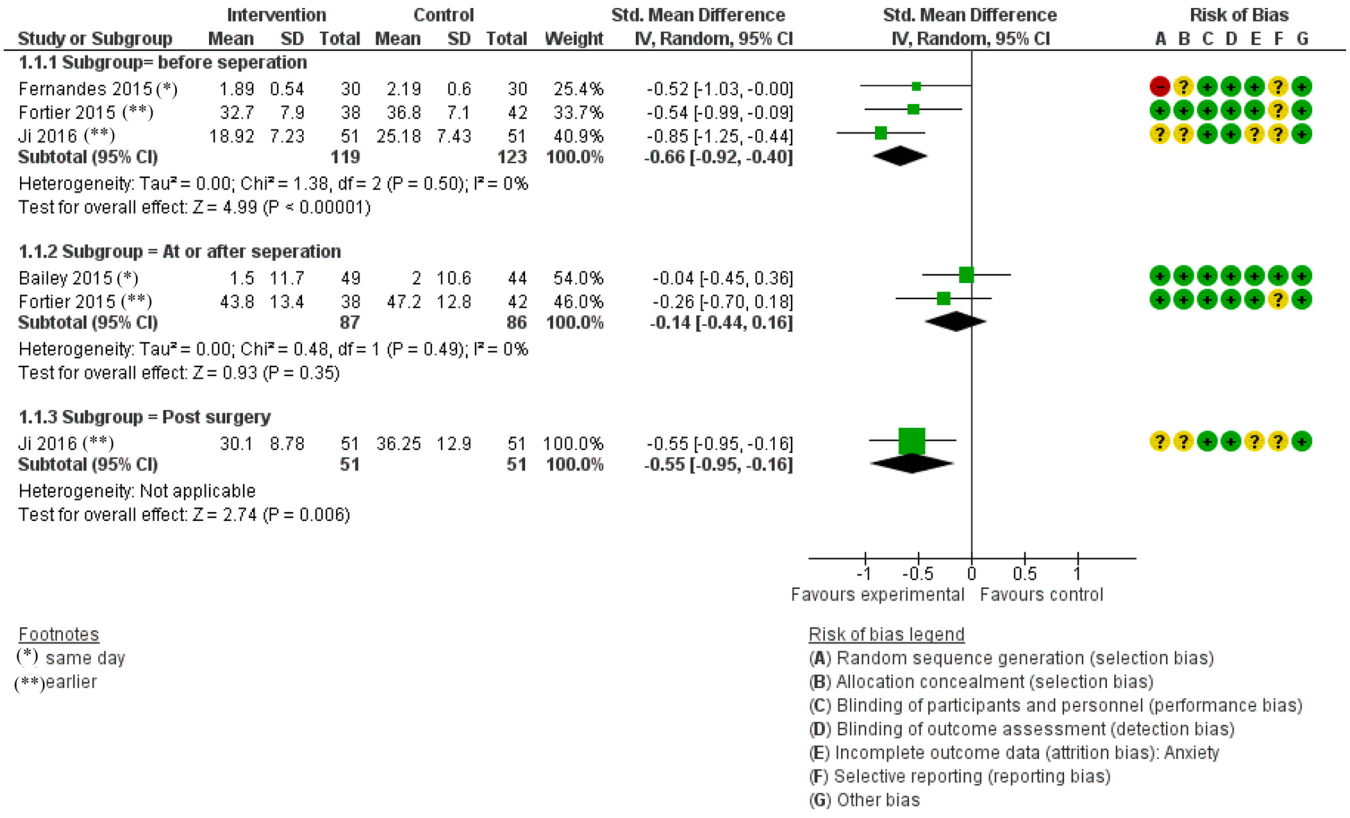

Fig. 4. Meta-analysis on the effect of web-based interventions on parental anxiety.

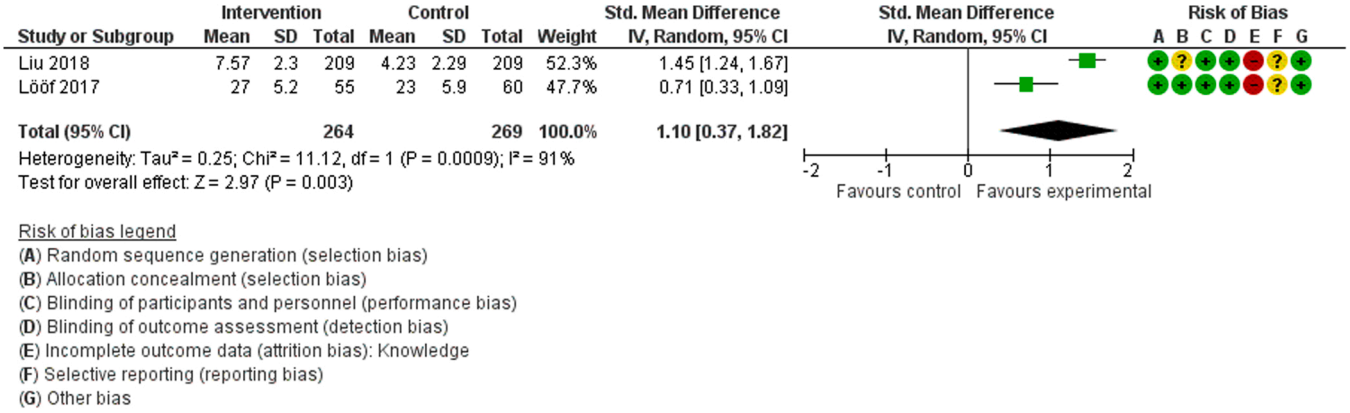

Fig. 5. Meta-analysis of the effect of web-based intervention on parental knowledge.

with health personnel during intervention, either by e-mail [32] or by a telephone call 72 h prior to the scheduled procedure [36].

3.2. Outcome

Parental anxiety was measured in five studies using the instruments STAI [30,34–36] and APAIS [29]. Two studies had baseline measurements of parental anxiety [29,30]. Post intervention measurement varied from being performed before separation from the child [29,34–36], at or immediately after separation [30,35], and after surgery [29].

Parental knowledge was measured in two studies [32,33]. Lööf et al. [33] measured parental knowledge about anesthesia, while Liu et al. [32] examined parental knowledge related to hernia, preparation for the children, and possible postoperative complications observed at home. In both studies, measurements were performed before surgery.

Parental satisfaction with preparatory information was measured in three studies [29,31,36]. Measurements were performed by telephone interviews 6–48 h after discharge applying different measurements tools including the Treatment Evaluation Inventory (TEI) [31], the Patient Satisfaction with Preoperative Anesthetic Care questionnaire (PSPACq) [29], and an investigator-developed tool [36]. One study also measured parental satisfaction prior to discharge applying a Visual Analogue Scale (VAS) [31].

3.3. Risk of bias in included studies

Detailed descriptions of RoB in the eight included studies are presented in "Characteristics of included studies" (Appendix C), as and RoB graph and RoB summary (Fig. 2, Fig. 3).

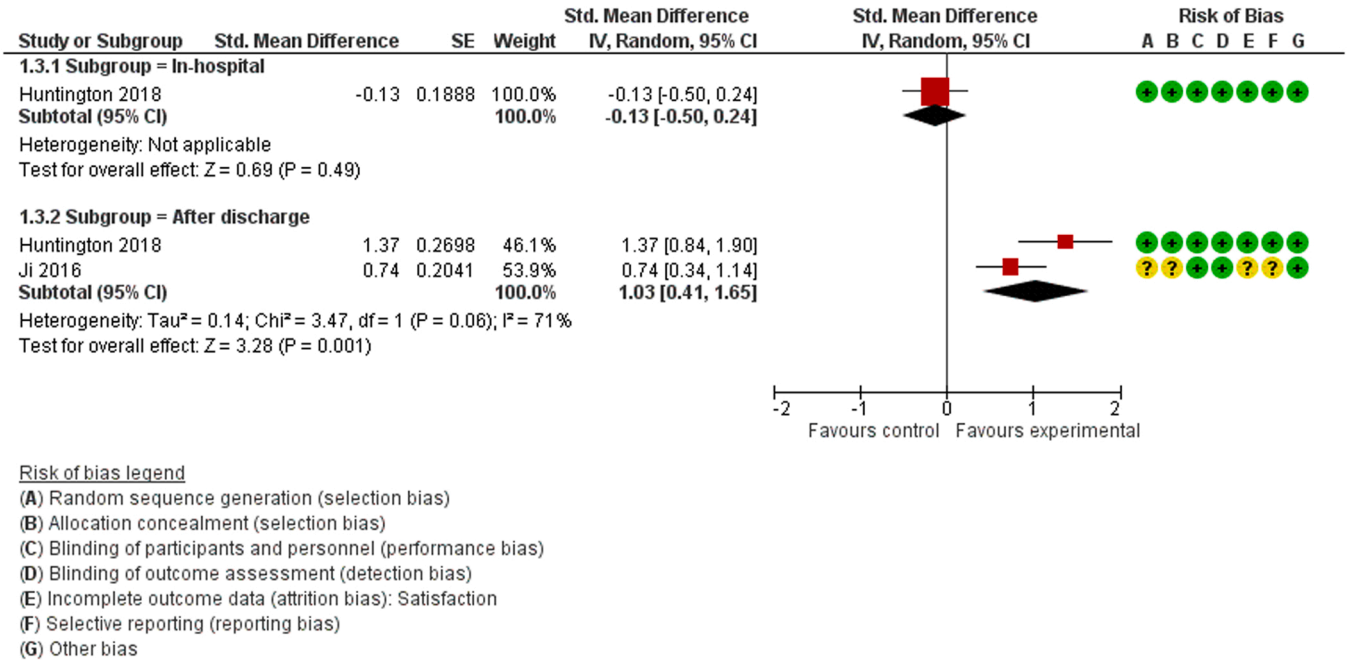

Fig. 6. Meta-analysis on the effect of web-based interventions on parental satisfaction.

3.4. Effect of intervention

3.4.1. Parental anxiety

The meta-analysis of parental anxiety included four studies [29,30,34,35]. Pooled results indicated less anxiety with web-based pre-operative information as compared to standard information (SMD = −0.43, 95% CI = −0.71 to −0.15, p = 0.002, I^2 = 43%). In analyses for subgroups defined by timing of assessments, we found similar results for anxiety assessed before separation from the child (SMD = −0.66, 95% Cl = −0.92 to −0.40, p < 0.001, I^2 = 0%) and also after surgery (SMD = −0.55, 95% CI = −0.95 to −0.16, p = 0.01), but not at or immediately after separation from the child (SMD = −0.14, 95% CI = −0.44 to 0.16, p = 0.35, I^2 = 0%) (Fig. 4). Results in subgroups were statistically significant (p = 0.03). A fifth study [36] reporting p-values only, did not confirm an effect of the intervention for measurements before separation, neither among mothers (n = 62, p = 0.20) nor fathers (n = 8, p = 0.69).

There was no clear indication of an impact of whether parents were given access to the information the same day as the surgery [30,34], or earlier [29,35] (Fig. 4).

3.4.2. Parental knowledge

Two studies measured parental knowledge [32,33], on operation day, before surgery at the hospital. The pooled result indicated increased knowledge with web-based pre-operative information as compared to standard information (SMD = 1.10, Cl 95% = 0.37 to 1.82, p = 0.003, I^2 = 91%) (Fig. 5).

3.4.3. Parental satisfaction

Three studies measured parental satisfaction [29,31,36]. Pooled results did not indicate higher satisfaction with web-based pre-operative information as compared to standard information (SMD = 0.64, 95% CI = −0.20 to 1.49, p = 0.14), but heterogeneity between study results was considerable (I^2 = 91%). Subgroup analyses based on timing of assessments showed that in contrast to measurements performed in-hospital (SMD = −0.13, 95% CI = −0.50 to 0.24, p = 0.49), satisfaction was increased for web-based information compared to standard information when satisfaction was measured after discharge (SMD = 1.03, 95% Cl = 0.41 to 1.65, p = 0.001, I^2 = 71%) (Fig. 6). Results in subgroups were statistically significant (p = 0.002). A fifth study [36] reporting p-values only, corroborated findings for satisfaction assessed after discharge (p = 0.004).

The impact of the timing of the intervention was not evaluated for parental knowledge and parental satisfaction because all relevant studies gave parents access to information at least one day before surgery. The number of times that parents read the web-based information could not be evaluated for any of the outcomes as none of the included studies investigated this factor.

3.5. Certainty of the evidence

The certainty of the evidence varied from very low to moderate (Table 2). All outcomes were downgraded by 1 due to imprecision and two outcomes were further downgraded 1 level as the evidence was based on one study only. Four of the six outcomes were downgraded an additional level due to risk of bias, either selection bias or attrition bias, and/or unclear risks of bias on several criteria.

4. Discussion and conclusion

4.1. Discussion

This systematic review indicated an effect in favour of web-based preoperative information compared to standard care on parental level of anxiety, knowledge, and satisfaction. The results, however, depended on the timing of assessments. We did not observe an effect in favour of the intervention on parental anxiety when assessed at or immediately after separation from the child, and on parental satisfaction when measured in-hospital. The certainty of the evidence varied from very low to moderate.

The review findings are supported by another systematic review that has examined the effectiveness of audiovisual interventions aimed at reducing anxiety in parents whose children were undergoing elective surgery [13]. Our findings also coincide with reviews that have included pre-education program interventions delivered as video [37,38] and smartphone applications [39], while internet education resources [39] increased parental knowledge and patient satisfaction but had no impact on parental anxiety. However, these findings were based on few studies,

Table 2
Summary of findings table on the effect of web-based versus standard pre-operative information on parental anxiety, knowledge, and satisfaction.

Web-based information compared to standard information for parents with children undergoing elective ambulatory surgery				
Population: parents with children undergoing elective ambulatory surgery Setting: ambulant pediatric surgery performed in general anesthesia at a hospital, physician's office or surgical center Intervention: web-based information Comparison: standard information				
Outcomes	Anticipated absolute effects (95% CI) Risk with web-based information compared to standard information*	N° of participants (studies)	Certainty of the evidence (GRADE)	Comments
Anxiety before separation	SMD 0.66 SD lower (0.92 lower to 0.4 lower)	242 (3 RCTs)	⊕⊕◯ LOW[a,b]	Web-based information may reduce anxiety measured before separation from child. Test for overall effect: Z = 4.99, p < 0.001. An additional study (O'Conner-Von., 2008) reporting only p-values, did not support the finding (p ≥ 0.2).
Anxiety at or after separation	SMD 0.14 SD lower (0.44 lower to 0.16 higher)	173 (2 RCTs)	⊕⊕⊕◯ MODERATE[b]	Web-based information likely does not reduce anxiety measured at or after separation from child. Test for overall effect: Z = 0.93, p = 0.35.
Anxiety after surgery	SMD 0.55 SD lower (0.95 lower to 0.16 lower)	102 (1 RCT)	⊕◯◯◯ VERY LOW[c,d]	The evidence is very uncertain about the effect of web-based information on anxiety after surgery. Test for overall effect: Z = 2.74, p = 0.006.
Knowledge in-hospital	SMD 1.1 SD higher (0.37 higher to 1.82 higher)	533 (2 RCTs)	⊕⊕◯◯ LOW[b,e]	Web-based information may increase in knowledge measured in-hospital. Test for overall effect: Z = 2.97, p = 0.003.
Satisfaction in-hospital	SMD 0.13 SD lower (0.5 lower to 0.24 higher)	111 (1 RCT)	⊕⊕◯◯ LOW[d]	Web-based information may not reduce satisfaction measured in-hospital. Test for overall effect: Z = 0.69, p = 0.49.
Satisfaction after discharge	SMD 1.03 SD higher (0.41 higher to 1.65 higher)	213 (2 RCTs)	⊕⊕◯◯ LOW[b,c]	Web-based information may increase satisfaction after discharge. Test for overall effect: Z = 3.28, p = 0.001. An additional study (O'Conner-Von., 2008) reporting only p-values, supported the finding (p = 0.004).

CI: Confidence interval; SMD: Standardised mean difference
* As a rule of thumb, 0.2 SDs represent a small difference, 0.5 a moderate difference, and 0.8 a large difference.
GRADE Working Group grades of evidence
High certainty: We are very confident that the true effect lies close to that of the estimate of the effect
Moderate certainty: We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different
Low certainty: Our confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect
Very low certainty: We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect

[a]Downgraded by 1 due to serious risk of selection bias, as well as unclear risks for bias on other criteria.
[b]Downgraded by 1 due to serious imprecision.
[c]Downgraded by 1 due to serious unclear risks of bias.
[d]Downgraded by 2 due to serious imprecision and inclusion of only one study.
[e]Downgraded by 1 due to serious risk of attrition bias, as well as unclear risks of bias for other criteria.

and it is not evident that the educational programs were web-based. Comparisons should therefore be performed with caution.

Chow et al. [13] states that the timing of outcome assessments should be investigated as a moderating variable, and points to the time around anaesthetic induction as particularly important. Our review showed that the timing of parental anxiety assessments may be an important factor, with results for web-based and standard information being similar for assessments performed as parents were accompanied out of the operating room after the induction of anesthesia [30], or immediately after separation from the child [35]. An explanation might be the greater stress this situation possibly represents on the parents [40]. While our finding indicated that web-based information likely does not reduce anxiety at or after separation from the child, the result was based on two relatively small studies. We therefore suggest that the topic is further elucidated in future studies to substantiate our finding and to improve on web-based pre-operative information. Another moderator may be the timing of when the intervention is implemented [13], but this was not demonstrated in this review.

The very low to moderate certainty of the evidence in this review represents a limitation. As only a few studies with relatively small sample sizes met the inclusion criteria, the evidence was downgraded for all outcomes. In addition, we downgraded four of the six outcomes due to risk of bias. There might also be methodological limitations due to recalculations of the reported results. These recalculations were based on statistical assumptions that could not be verified in a stringent manner. Further, although the meta-analyses were based on both post scores and change scores, we applied SMDs to estimate intervention effects. While not demonstrated in practice [41] this may represent a bias in summary measures.

There may also be ambiguities as to what should be considered as web-based information. We defined this to be information accessible from a web page or website, either directly or indirectly from downloadable data applications. This broad definition led to inclusion of interventions that varied in form, and probably also in quality. It has also been reported that the content of internet-based resources frequently does not concur with current guidelines [7]. There is reason to believe that if the quality of web-based interventions were evaluated after a common standard method it would strengthen the results of each study and thus also systematic reviews [42].

4.2. Conclusion

Depending on the timing of assessment, web-based information before pediatric elective surgery may reduce the level of parental anxiety and increase the level of parental knowledge and satisfaction more than standard care. The certainty of the evidence varied from very low to moderate.

4.3. Practice implications

This systematic review indicated that web-based routines can be used to convey pre-operative information to parents before paediatric ambulatory surgery. An obvious advantage of web-based information is that it is readily available to be studied anywhere and at any given time. Updated material is also easily disseminated and can reach the public instantaneously after being published. An argument against its use could

be limited availability of necessary hardware, especially in low- and middle-income countries. This may be countered by use of responsive web designs that make information accessible across devices, including on mobile phones.

Still, further research is needed to substantiate our findings, with standardized evaluation of web-based information, and especially standardized research to better enable comparison across studies.

Ethics

No ethical approval was needed for this systematic review.

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CRediT authorship contribution statement

Kari Louise Nytun: Conceptualization, literature strategy and search, data extraction, formal analysis, writing. **Irene Ohlen Moldestad:** Conceptualization, literature strategy and search, data extraction, formal analysis, writing. **Anne Kristin Snipsøer**: Data extraction, writing. **Birgitte Espehaug:** Data extraction, formal analysis, writing.

Declaration of Competing Interest

The authors have no relevant conflict of interest to disclose.

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Appendix. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.pec.2022.09.006.

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