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ORIGINAL ARTICLE

Positive effects of a child-centered intervention on children's fear and pain during needle procedures

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Abstract

To examine whether children experience less fear or pain using a child-centered intervention and if there were differences between the intervention group and the control group regarding heart rate, time required for the procedure, success rate for the cannula insertion, and patient satisfaction. A controlled single-center case study of observational design, with one control and one intervention group. Child self-reported fear or pain levels did not reveal any differences for those receiving the intervention compared with controls. However, according to a behavioral observation measure with the Procedure Behavior Check List, effects of the intervention were lower distress in relation to fear and pain during the cannula insertion. The time it took to perform the cannula insertion also decreased significantly in the intervention group. More children in the intervention group reported that they were satisfied with the needle procedure compared with the children in the control group. The child-centered intervention provides reduced observed distress related to fear and pain in children undergoing a cannula insertion and reduced total time by more than 50%. This study found that child involvement in care strengthen their ability to manage a needle procedure.

KEYWORDS
child-centered care, fear, needle procedure, pain

1 | INTRODUCTION

While needle procedures in pediatric care are well researched, children still report needle procedures as the worst source of fear and pain during hospital care and treatment.[1,2] Although fear and pain are strongly associated and affect each other, it is suggested that children from the age of 7 years can differentiate between these two emotional experiences.[3] Children under the age of 12 years report more fear than pain in connection with needle procedures.[3] This highlights the importance of child self-reporting fear and pain during a needle procedure.[4] The experiences of fear and pain can be learned and remembered from previous experiences and can lead to physiological, psychological, and emotional consequences that may be difficult to overcome.[5]

Both topical anesthesia and psychological interventions, such as distraction, can reduce children's fear and pain during needle procedures.[1,6] However, for those children who prefer to have control and to be involved in the needle procedure, a distraction intervention may be distressing, rather than helpful, and may impact the child negatively.[7] It is suggested that care and treatment that involve children's participation through child-centered care,[8] lead to a better care experience.[9] Child-centered care acknowledges the child and his/her cognitive, cultural, legal challenges, and limitations.[10] By offering the child choices around participation and involvement in

connection with needle procedures,[11] nurses may take advantage of the child's own ideas on how to reduce the possible fear and pain.

Thus, a child-centered intervention aiming to reduce fear and pain during needle procedures was developed based on the children's preferred choices. The primary objective was to examine whether children experience less fear and pain in connection with a routine peripheral needle procedure when receiving standard care with the addition of the intervention compared with the experience of standard care only. Secondary objectives were to investigate any differences between the intervention group and the control group regarding time required for the procedure, heart rate, success rate for the needle insertion, and patient preference to undergo the needle procedure in the same way again.

2 | PATIENTS AND METHODS

2.1 | Design

This study was a controlled, single-center, case study of observational design, with one control group and one intervention group. The intervention group received standard care plus the addition of a child-centered intervention and the control group received standard care only.

2.2 | Participants and setting

Inclusion criteria were children aged 6–12 years undergoing a peripheral cannula insertion prior to a planned operation, who were able to express themselves verbally and understand the instructions for the intervention and reported fear and pain measurements (Table 1). Children with severely impaired cognitive ability were excluded. Figure 1 illustrates a flow diagram of the children who participated in the intervention and control groups.

The study was conducted at a pediatric day-clinic at a general hospital in Sweden. Children in the control group were consecutively included from December 2019 until March 2020. For the intervention group, the data collection continued from August 2021 until January 2022. Due to the COVID-19 epidemic, a temporary closure of the day clinic was enforced. Before the closure of the clinic, 10 children from the intervention group had been included. When the clinic reopened, the standard care for cannula insertion was compared before and after the clinic was closed. No changes were identified in standard care, and the nurses performing the procedure were the same as those prior to closure.

TABLE 1 Background characteristics.

	Intervention group $n = 65$	Control group $n = 40$
Girls/Boys (n)	26/39	14/26
Age—median (range)	10.0 (6–12)	7.0 (6–12)
Need for language interpreter (n)	3	5

2.3 | Procedure

The study was approved by The Swedish National Ethical Review Board (Dnr 2019–04927). After the children had given their assent and parents had given consent to inclusion in the study, the children received standard care, consisting of topical anesthesia patches, for a minimum of 1 h before the cannula insertion; the children also received information according to the routines. Children in the intervention group received standard care plus the addition of a child-centered intervention. The same material and routines for the cannula insertion were used during the entire study period. One, or in some cases, two nurses participated during the cannula insertion, depending on the child's age and if it was already known that the child was afraid of needles.

Before the cannula insertion started, the first author, IK, asked all children to self-report their experiences of fear and pain using four different scales. A pulse oximeter was attached to the child's finger. Data collection began just before the nurse removed the anesthetic patches and ended when the child had received a bandage. Immediately after completion of the cannula insertion, the child again self-reported their fear and pain, and IK noted the heart rate. The behavioral observation was performed by IK from the bedside during the cannula insertion. IK was available to support the child, if necessary, during the intervention. The accompanying parent was present with the child throughout the cannula insertion. After completing the cannula insertion, the child was asked the follow-up question "Would you be satisfied with undergoing the cannula insertion in the same way again, if needed in the future?". The answer options were yes and no. For an overview of the study process for the data collection, see Figure 2.

To control for the risk of influencing the nurses and to avoid the so-called "spill over" effect between the control and intervention groups, the control group was studied first.

2.4 | The child-centered intervention

With the aim of reducing the experience of fear and pain that is associated with needle procedures, a child-centered intervention was developed. The child-centered intervention intends to give the child support and improve health outcomes by offering a choice of strategy or strategies the child needs to manage the needle procedure. The intervention consisted of a choice of strategies preferred by children[12] and presented as pictures. These pictures were designed to facilitate the child's choice of strategy.

When children during care and treatment are allowed to be decision makers, healthcare professionals create conditions for increasing children's autonomy,[12] which can lead to a high degree of participation.

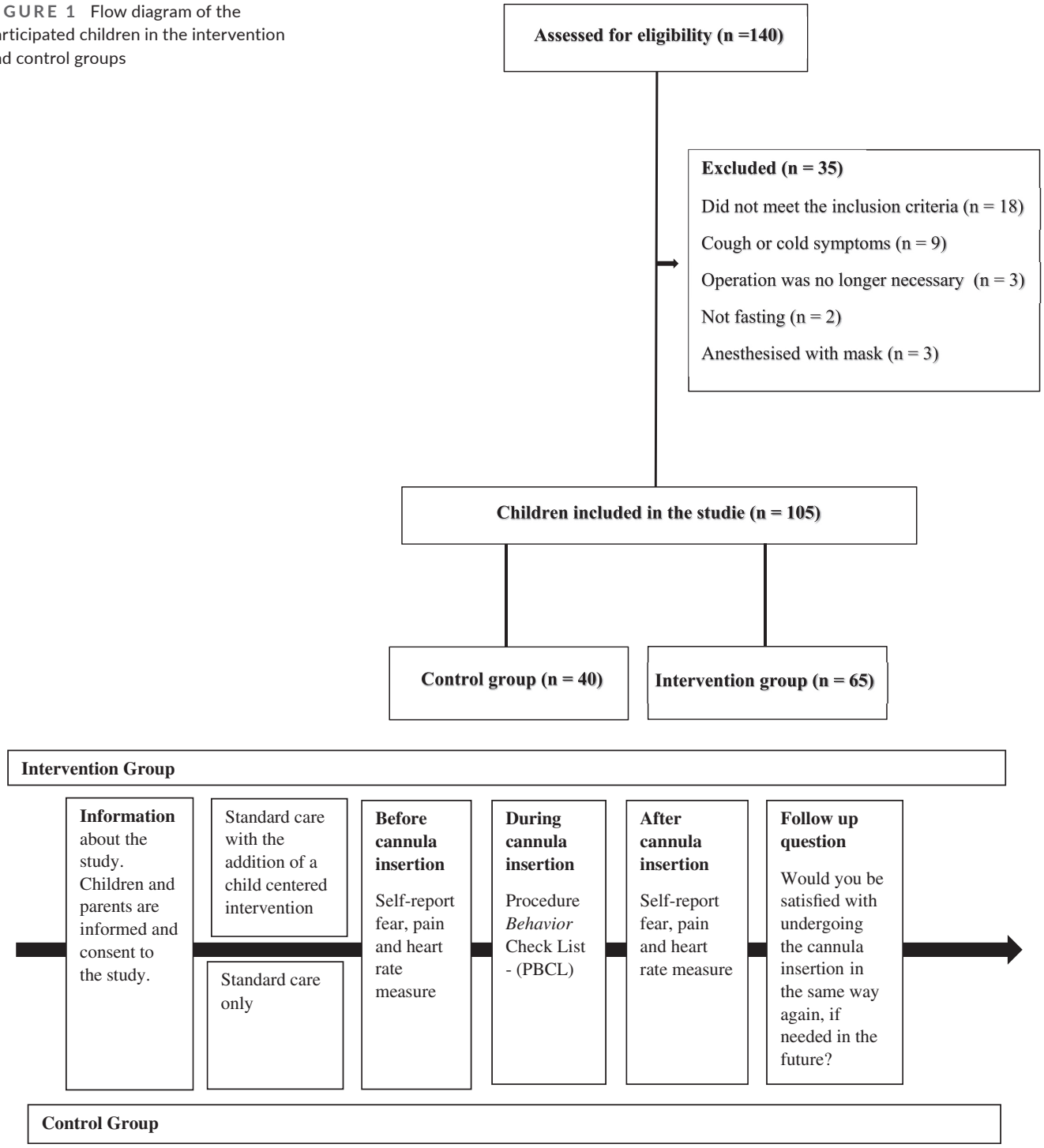

FIGURE 1 Flow diagram of the participated children in the intervention and control groups

FIGURE 2 The study process for data collection

The intervention required that each child looked at an image consisting of nine different strategy choices of how and if they wanted to be involved, before the cannula insertion began. For an overview of the intervention strategy image, please see Appendix A. The proposed strategies were presented as nine pictures of strategies that aimed to reduce any fear and pain experienced by the child. One picture was blank with the intention of eliciting the child's own chosen strategy. The children decided for themselves if and which strategies they wanted to use. Throughout the entire cannula insertion, the child could change strategies or use several different strategies.

For all canula insertions, it was IK who applied the intervention. The child or IK informed the nurse how to use and prepare the chosen strategy.

2.5 | Outcomes measures

The main outcome was self-reported fear. Self-reporting is suggested to be the golden standard on symptom burden reports. Earlier studies have concluded that fear levels are higher than pain levels during

needle procedures. We therefore choose self-reported fear as the primary outcome. In addition, observation measure on pain and behavioral distress was made. The Numeric Rating Scale-Unpleasant (NRS-U) and Children's Fear Scale (CFS) were used for self-reported fear level, and the NRS-Pain (NRS-P) and the Face pain scale Revised (FPS-R) were used for the self-reported pain level. NRS-U and NRS-P are validated and recommended for children from the age of 6 years.[13,14] The child points to a number between 0 and 10 to estimate experienced pain. When using the CFS and FPS-R, the child is asked to point to faces, from a sad or tormented face to a neutral or smiling face, that correspond to the degree of pain or fear the child experiences. CFS is validated for ages 5–10 years,[15] and FPS-R is validated for use in children from 4 years of age.[16] We suggest that assessing fear and pain with different instruments may help children distinguish between the experience of fear and pain. Using both facial and numerical scales is motivated on the basis that younger children tend to answer questions even if they do not understand the meaning of their answers. Furthermore, the child's ability to reason numerically affects how the child estimates numerically. Girls tend to have an increased ability to quantify their perceived unpleasant emotional reactions compared to boys.[13] So, children sometimes prefer face scales and sometimes numerical scales. In addition to children's self-reported fear and pain, an observation measure, using the Procedure Behavior Check List (PBCL), was performed by IK. For a physiological measure, each child's heart rate (beats per minutes) was measured. Success rate of the cannula insertion was noted. Time in minutes and seconds for the whole cannula insertion was measured using a stopwatch.

2.6 | Statistical analysis

For the primary outcome variable, fear, a minimum of 100 participants for a clinically relevant difference was needed.[17] This was in accordance with a sample calculation with an estimated loss of 20%, based on a calculated power of 0.80 and an alpha value of 0.05, assuming a standard deviation of 20 mm and a 13–18 mm reduction of fear (visual analog scale: 0–100 mm). Similar values exist for calculating the variables of pain and unpleasantness.[18]

Descriptive statistics were used for background characteristics. To examine differences between the control and intervention groups regarding current fear, pain, and time required, data were analyzed using the Mann–Whitney *U*-test (two-sided). Pearson's chi-squared tests were used to analyze differences of success rate of the cannula insertion and for the question concerning child preference for undergoing cannula insertion in the same way in the future, if required. The alpha level was set to 0.05.

SPSS, version 27.0.0 (IBM Corp), was used for the statistical analyses.

3 | RESULTS

Of 140 children who were approached to participate in the study, 105 children were finally included. In all, 18 children were excluded, and 17 children declined to participate. The patients who declined participation did not differ from the others with regard to the background characteristics described in Table 1. The intervention group was comprised of 65 children, and the control group was comprised of 40 children. There were no statistical differences in sex. Nor were there any differences between the intervention group and the control group regarding self-reported fear levels, self-reported pain levels, or heart rate before the cannula insertion (Table 2).

TABLE 2 Self-reported fear and pain levels and observed heart rate before the cannula insertion

	Intervention group $n = 65$		Control group $n = 40$		
	Mdn	Range	Mdn	Range	*p*
Fear (NRS-U)	3.5	10	2.0	10	0.219
Fear (CFS)	1.0	4	1.0	4	0.259
Pain (NRS-P)	0.0	10	0.0	10	0.512
Pain (FPS-R)	0.0	10	0.0	10	0.939
Heart rate	81.5	72	87.0	70	0.300

Abbreviations: CFS, Children's Fear Scale; FPS-R, Face pain scale Revised; NRS-P, NRS-Pain; NRS-U, Numeric Rating Scale-Unpleasant.

3.1 | Self-reported fear and pain

There were no significant differences in child self-reported fear levels or pain levels in the intervention compared with the control group, using both numeric and face scales (Table 3).

3.2 | Observed fear and pain

The scores from the behavioral observations (PBCL) of fear and pain were lower in the intervention group ($n = 63$, Mdn = 1.0) compared with the control group ($n = 39$, Mdn = 4.0), $U = 786.5$, $p = 0.002$, two-tailed (Table 4).

3.3 | Time required for the cannula insertion

Total time (minutes) for the cannula insertion was shorter in the intervention group ($n = 65$, Mdn = 2.5) compared with that in the control group ($n = 39$ Mdn = 4.5), $U = 476.5$, $p = 0.001$, two-tailed (Table 4).

3.4 | Heart rate and success rate

There were no differences between the groups in measured heart rate change. However, when using the intervention, 61.5% of the children in the intervention group had an increased heart rate change compared with 57.5% of the children in the control group, when comparing each child before and after measurement. Nor were

TABLE 3 Self-reported fear and pain levels, procedure time, and observed heart rate change after the cannula insertion

	Intervention group ($n = 65$)		Control group ($n = 40$)		
	Mdn	Range	Mdn	Range	*p*
Fear (NRS-U)	2.0	10	3.5	10	0.619
Fear (CFS)	1.0	4	1.0	4	0.125
Pain (NRS-P)	1.0	10	1.5	10	0.494
Pain (FPS-R)	0.0	10	0.5	10	0.127
Time (minutes)	2.5	6.8	4.5	16.2	<0.001
Heart rate change	6.5	94	14	87	0.202
Children with increased heart rate change n (%)	40 (61.5)		23 (57.5)		

Abbreviations: CFS, Children's Fear Scale; FPS-R, Face pain scale Revised; NRS-P, NRS-Pain; NRS-U, Numeric Rating Scale-Unpleasant.

TABLE 4 Behavior observation during the cannula insertion

	Intervention group ($n = 65$)		Control group ($n = 40$)		
	Mdn	Range	Mdn	Range	*p*
PBCL	1.0	38	4.0	40	0.002

TABLE 5 Success rate and the follow-up question between the intervention group and the control group

					Pearson's chi-square test			
Variable	Intervention group n		Control group n		*df*	x^2	*p*	Cramer's V
Success rate (number of needle punctures)	1 (%)	2 > (%)	1 (%)	2 > (%)	1	2.4	0.122	0.152
	61 (93.8)	4 (6.2)	33 (82.5)	6 (15)				
If the child was satisfied with undergoing the cannula insertion in the same way again	Yes (%)	No (%)	Yes (%)	No (%)	1	12.4	<0.001	0.343
	58 (89.2)	7 (10.8)	24 (60)	16 (40)				

there any differences in success rates of cannula insertion between the intervention group and the control group (Table 5). Self-reported levels of fear and pain between those children with success rates of one puncture through the skin compared with those with two or more punctures through the skin showed no statistical differences.

3.5 | Child's satisfaction with the cannula insertion

A higher number of children in the intervention group reported that they were satisfied with the cannula insertion compared with the children in the control group ($x^2 = 12.4$, $df = 1$, $n = 105$, $p < 0.001$). Further analysis with Cramer's V ($V = 0.343$) shows a strong connection between the children in the intervention group and being satisfied with the cannula insertion. For an overview of the children's answers in each group, see Table 5.

4 | DISCUSSION

This controlled case study evaluates a child-centered intervention in connection to cannula insertion. The intervention, as described earlier, aimed to strengthen the child's involvement in their own care through following the child's chosen strategies during a cannula insertion. The analysis of self-reported fear or pain levels could not detect any differences between receiving the intervention and receiving standard care only. However, a positive effect of the intervention was detected, showing lower fear and pain levels during the cannula insertion according to the PBCL. Children who exhibit behavioral distress have increased muscle tension and find it more difficult to be still.[19] This behavior that affects the child physiologically and risks making needle procedures such as a cannula insertion more difficult. The child-center intervention used in this study contributed to reduced behavioral distress and pain and could therefore be valuable in reducing psychological and physiological distress. Thus, it can be assumed that children who are at ease and not distressed due to perceived fear or pain are more likely to accept a needle procedure.

Younger children who experience fear or pain in connection to cannula insertion demonstrate a more active behavioral distress. Crucial for the child's behavioral distress in connection with needle procedures was reported to be the child's coping ability with pain, earlier experiences, and parents' expectations of the child's behavior in response to pain.[20] By observing the child's facial expression and posture, healthcare professionals can get information about the

child's experience of distress. Behavioral signals are important information to consider when assessing a child's fear and pain.[21] As previous study showed,[22] when using the intervention, the child is encouraged to use their own or proposed strategies to increase the ability to cope with fear and pain. It is, therefore, conceivable that children in the intervention group with significantly lower PBCL scores experienced reduced fear.

This study results are in line with Giljam et al.'s suggestion that children who are involved in their own care experience less fear and distress and increased well-being.[19] The behavioral distress exhibited by children when experiencing fear or pain in connection with needle procedures could be reduced by participation.[19] Similarly, Andersson et al. showed the importance of listening to children's wishes and encouraging participation when children experience fear.[23] When a child experiences fear of a procedure, it is probable that the child could experience a loss of control. One way to help the child regain control is by involving the child in decisions about the procedure. By letting the child make decisions for themselves during the procedure, the child's sense of control can increase, and their fear will decrease.[23] Nurses are obliged to involve children in their care and treatment according to the United Nations Convention on the Rights of the Child,[24] which has been the law in Sweden since 2020. The intervention gave the children the opportunity to choose how and if they wanted to be involved while the procedure was taking place. Involving children in their care and treatment to promote participation is becoming standard practice. However, participation-based strategies designed to reduce the child's fear and pain are not self-evident.[25]

The time required for a cannula insertion was more than halved using the intervention, which is interpreted as positive effect for the child's experience. It is possible that by making the child more involved the cannula insertion, it became less fearful and more accepted. It is probably desirable from the child's perspective to carry out the cannula insertion as quickly as possible, but it is also important to give the child time for preparation and processing, which aims to prevent needle-related fear in children.[26] Furthermore, procedures performed without taking the necessary time for care can negatively affect children and their future procedures.[25] The intervention requires time prior to the cannula insertion as the presentation of the intervention was not included in the timing. However, the puncture of the skin should never occur when the child is not prepared or ready. This can lead to a loss of trust and confidence in healthcare professionals. If, on the other hand, the child has chosen to be distracted, the puncture of the skin should occur when the child may not be aware of it.

The intervention was presented before the timing of the cannula insertion started. Another explanation for the reduced time may be that the children in the intervention group created a contact built on trust with IK before the cannula insertion began. When a relationship of trust is created between the child and the nurse, the child experiences more satisfaction, which leads to reduced experiences of fear.[27] Even if the conversation with the child before the cannula insertion requires some minutes when the intervention is presented, it is still conceivable that a faster completed cannula insertion with success rate of one gives the child a more positive experience compared with a cannula insertion that takes time owing to the child not participating in the procedure.

All children in this study were asked, "If needed another time, would you be satisfied with undergoing the cannula insertion in the same way again," with the answer options of yes or no. There was a significant difference between the groups, such that the children in the intervention group were found to answer yes to a greater extent compared with the children in the control group. The fact that the children themselves carry with them the experience of a successful cannula insertion is considered to be successful. Using the intervention, the cannula insertion is performed in collaboration between the child and the nurse. When the child is given the opportunity to choose how and if they want to be involved during the cannula insertion, it helps to ensure support of the child's needs.[28]

4.1 | Strengths and Limitations

This study included a small sample, so it could be unpowered to detect differences of self-reported fear and pain levels. The main strength of this study was that the effect evaluation of the intervention was based on the children's self-reports combined with observation and physiological measures. Healthcare professionals tend to both over- and under-estimate children's experiences fear and pain; therefore, a child's own experiences should always be sought whenever possible.[29] No significant effects were found either with numerical self-reports or face-scales report, which may support the assumption that the children understood the meaning of their estimates.

A combination of self-reports and behavioral observational measures is recommended to optimize an individual support, which may lead to communication and reduced fear and pain.[30] Some children want to be brave and manage how much fear or pain they show. Performing behavioral observations was used as a complement to the self-reports. By adding a physiological parameter, such as heart rate change, the effect of the intervention was evaluated based on one more perspective related to a child's experiences of fear and pain during needle procedures. The intervention was based on child-centered approach to care and the results show that we should listen to the child and actively seek their involvement.

Using a controlled, single case study design allowed the control group to experience the procedure first and only then was the data collection for the intervention group started. The reason for this was not to disclose the intervention to the nurses performing the cannula insertion, as we hypothesized that the intervention may affect their attitudes toward making the child more involved in the cannula insertion.

Inclusion criteria for this study were children 6–12 years undergoing cannula insertion prior to a planned operation, as children in this age group experience higher levels of fear in connection with needle procedures.[3] Furthermore, the children needed to be able

to express themselves verbally, have the capability to understand the instructions for the intervention and be able to self-report fear and pain levels to evaluate the intervention. An additional strength of this study was its use of a language interpreter for those children who did not fully speak Swedish. This was used to enable greater understanding of the child before giving assent to participate in the study and to increase the understanding of self-reported fear and pain. Still, the intervention may be suitable for all children, including children with severely impaired cognitive ability. Because the intervention is based on the opportunity to choose how and if the child wants to be involved while the procedure is taking place.

There may be a risk of observer bias when assessing the PBCL. Performing behavioral observations was used as a complement to the self-reports. It was a strength to use the same instrument for all children which was assessed by the same person. PBCL adds the observational perspective to self-report to measure pain and distress during needle procedures. The risk when using PBCL could be to miss the child's more discreet behaviors. All behavioral observations were carried out by IK who is trained in children's non-verbal communication, which can be seen as a strength as all children are assessed based on the same premises. In order not to reward the children in the intervention group with higher scores during PBCL observations, it is recommended that the PBCL is carried out together with the child's self-assessment.[30]

A limitation of the study may be the imbalance in the study groups. There was a higher number of children in the intervention group compared with that in the control group, due to changes in the number of day-ward procedures being carried out during the COVID-19 pandemic. Children's ages differed between the groups, but this is not considered to have affected the results, as younger children experience fear to a higher extent compared with older children, and the groups did not differ regarding self-reported fear or pain prior to the cannula insertion.

5 | CONCLUSIONS

This child-centered intervention involving individually chosen support strategies reduced observed distress in relation to fear and pain in children undergoing a cannula insertion and reduced the total time for the cannula insertion by more than 50%. It is possible that children's participation in their own care through this intervention made the cannula insertion became less fearful and more accepted which led to a time saving. This intervention can be of value for children undergoing needle procedure and suggest that it needs to be tested in a larger group.

CONFLICT OF INTEREST

None.

DATA AVAILABILITY STATEMENT

Research data are not shared.

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APPENDIX A