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Improving children's cooperativeness during magnetic resonance imaging using interactive educational animated videos: a prospective, randomised, non-inferiority trial

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ABSTRACT

Introduction: A previous prospective, randomized controlled trial showed that animated videos shown to children before their magnetic resonance imaging (MRI) scan reduced the proportion of children needing repeated MRI sequences and improved confidence of staying still for at least 30 minutes. Children preferred the interactive video. We hypothesize that the interactive video is non-inferior to showing two videos (regular and interactive) in improving children's cooperativeness during MRI scans.

Methods: In this Institutional Review Board-approved prospective, randomized, non-inferiority trial, 558 children aged 3 to 20 scheduled for elective MRI scan from June 2017 to March 2019 were randomized into interactive video only and combined (regular and interactive) videos groups. Children were shown the videos before their scan. Repeated MRI sequences, general anesthesia (GA) requirement, and improvement in confidence of staying still for at least 30 minutes were assessed.

Results: In the interactive video group (n = 277), 86 (31.0%) children needed repeated MRI sequences, 2 (0.7%) needed GA, and the proportion of children who had confidence in staying still for greater than 30 minutes increased by 22.1% after the video. In the combined videos group (n = 281), 102 (36.3%) children needed repeated MRI sequences, 6 (2.1%) needed GA, and the proportion of children who had confidence in staying still for greater than 30 minutes increased by 23.2% after videos, not significantly different from the interactive video group.

Conclusion: The interactive video group demonstrated non-inferiority to the combined videos group.

Keywords: pediatrics; radiology; quality improvement; Magnetic resonance imaging; Interactive Video

INTRODUCTION

Magnetic resonance imaging (MRI) is the imaging modality of choice in paediatrics as it provides high quality images that is free of ionising radiation.(1) The procedure requires that the patient be still during the scan which can take up to one hour.(2) This could prove difficult for children as the unfamiliar environment and staff, loud noises, confined space, and the need to lie still could contribute much to their anxiety and distress, causing them to become un-cooperative during the scan.(3) The resulting motion artefacts could lead to non-diagnostic scans, thus necessitating repeated examinations. Such repeats may be done under general anaesthesia (GA) or sedation, which has risks and complications of hypoxia, apnoea, vomiting, prolonged sedation and the need for assisted ventilation.(4) Avoiding GA and repeated or rescheduled scans can significantly reduce the length of the hospital visit, decrease overall procedure-related expenses and improve efficiency of patient flow.(5)

Several non-pharmacological strategies have been used in a paediatric medical environment to improve children's cooperativeness during their scans. These include parental involvement, pre-procedural preparation and use of distractions. Parents help to comfort and reduce anxiety by being physically present for their child. They can also help position and immobilise their child to improve image quality. Adequate pre-procedural preparation such as the use of a life-sized MRI simulator, a miniature MRI model, play therapy, hiring a child-life specialist, educational modelling films and animated videos can improve children's confidence in coping with the procedure and increase level of satisfaction and confidence in parents.(5-9) During the scan itself, distraction tools can be used. Toys, pacifiers, and other comfort items can be brought in by the child's parents. Videos and movies are frequently used as distractions. Some computed tomography and MRI departments installed colour-light systems that not only serve as distractions by projecting light on the walls, but also give instructions during breath-holding sequences and provide positive reinforcement for cooperation.[5,7] However, due to space constraints, limited clinical manpower and expenditure budgets, strategies such as mock MRI scanners, play therapy and installing colour-light systems in the MRI rooms may not be feasible.

Animated videos have been shown to be a very promising pre-imaging preparation tool as it is easily accessible and can be distributed online. Patients can view the videos anywhere and reinforce their knowledge of the procedure by watching the video multiple times. Animated videos had been shown to educate children about MRI scans and helped reduced anxiety in children 5 to 11 years old.[10] A randomised, controlled trial comparing the effect of full (simulator practice, movie and instructional booklet) and partial instruction (instructional booklet only) in children 5 to 16 years old showed that the group that had full instruction had 20% lower GA rates compared to the partial instruction group.[11] As these studies were either small, randomised studies or did not study the effect of videos alone, Ong et al (2018) conducted a larger, randomised controlled trial looking at the influence of educational animated videos on children's cooperativeness during MRI scans. In the three-arm study (control, regular animated video only and combined regular and interactive animated videos groups), it was shown that both intervention groups significantly decreased the number of children needing repeated MRI sequences and increased the proportion of children who had confidence in staying still for greater than 30 minutes. Without intervention, 47.7% required repeated sequences, while there was a 13% ($p = 0.005$) reduction in the proportion of children who needed a repeated MRI sequence in the regular video group and a 19.6% ($p < 0.001$) reduction in the combined videos group. The proportion of children who had confidence in staying still for greater than 30 minutes increased by 21% ($p < 0.001$) and 32.1% ($p < 0.001$) in the regular video group and combined videos group, respectively. There was no significant decrease in the proportion of children needing GA across the three groups.[2] In the combined videos group, the authors also found that the children generally preferred the interactive video to the regular video (unpublished data).

As compared to the regular video group, the combined videos group generally had a greater reduction in the proportion of children needing repeated MRI sequences and a greater increase in the children's confidence of staying still for more than 30 minutes. However, it is unknown which video contributed more to the outcome in the combined videos group.[2] Since this study only looked at the effect of regular video alone and more children liked the interactive video more than the regular video, we would now like to investigate the effect of the interactive video alone. We would like to study whether it is as efficacious as showing two videos in reducing the proportion of children needing repeated MRI sequences and GA, and increasing the proportion of children who had confidence in staying still for greater than 30 minutes. In this study, we would also be investigating whether the effect of videos differs among the various body parts being scanned.

METHODS

Over the period of June 2017 to March 2019, paediatric patients aged 3 to 20 scheduled for an elective MRI scan at the KK Women's and Children's Hospital were recruited and assessed for eligibility based on the inclusion and exclusion criteria. Inclusion criteria include patients between the age of 3 to 20 years old scheduled for the MRI scan and had never received the video intervention before. Exclusion criteria include patients who were already scheduled for GA, intubated, from the intensive care unit, children with autism spectrum disorder, children with Down's syndrome, and children who had altered mental state.

This study is an Institutional Review Board-approved prospective, randomised, non-inferiority trial. Patients were randomized into two groups: interactive animated video only and combined (regular and interactive) videos groups. The group to which each patient was assigned to was generated by a computer randomisation sequence and concealed within sequentially numbered, opaque, sealed envelopes. The patients were shown the videos at the waiting area before they go in for their MRI scan. The videos used in Ong et al (2018) study were used in this study. The regular animated video lasts 2 minutes and follows the story of Tim, a boy undergoing an MRI examination under the guidance of Dr Potato. Whereas, the interactive animated video lasts 2 to 3 minutes, and allows the patient to help a panda go through an MRI scan using touch buttons on the screen. Pre-recorded MRI sounds were incorporated into the interactive animated video. These videos were assessed and vetted by two child psychologists who deemed them suitable for the proposed age group.

Patients were asked to assess their confidence of staying still for at least 30 minutes before and after watching the videos. This threshold was chosen as it is the average duration of a MRI scan and is also the average duration of a cartoon show on television. Children needing repeated MRI sequences or GA were noted. The decision to conduct repeated MRI sequences or anesthetize the child was made by the radiologist and radiographer on duty based on the child's behaviour and diagnostic quality of the scans. Only moderate and marked motion artefacts that render a scan non-diagnostic will warrant a repeat scan. The decision to anesthetise the patient was based on the following criteria: (1) if no diagnostic images were achieved after three attempts at the initial sequence or (2) if the child refuses to cooperate and lie down on the MRI scan table. Only the professional who showed the videos and surveyed the patients was not masked to the group allocation.

Based on our previous experience,[2] 257 to 267 in each group was sufficient to demonstrate the differences in subjective (confidence in staying still for MRI) and objective outcomes (requirement for general anaesthesia, requirement for repeated MRI sequences). In this two-arm randomised trial, sample sizes of 273 in the interactive animated video group, and 273 in the combined regular and interactive animated videos group are needed to achieve 80% power to detect a non-inferiority margin difference between the group proportions of 11%. The proportion of repeated scans in interactive video group and combined videos group is assumed to be 41% and 30%, respectively, under the null hypothesis of inferiority. Power calculation was performed using non-inferiority test of difference in two sample designs in which the outcome is binary using the one-sided Z test (unpooled) via normal approximation to the binomial distribution. The significance level of the test is 0.025.

Statistical analysis was performed using the SPSS software program (IBM SPSS Statistics for Windows, version 23.0, Armonk, NY: IBM Corp). Data was summarized using mean and standard deviation for continuous variables, and frequency and percentage for categorical variables. Chi-square test was used to compare the proportion of children needing repeated MRI sequences and GA between the two groups. Independent two sample t-test was used to compare differences in age and scan duration between the two groups. McNemar's test for paired samples was used to compare the proportion of children confident of staying still for more than 30 minutes before and after the videos within each video group. Univariate and multivariable regression analyses were performed to assess the factors associated with the need for repeated MRI sequences. All *p*-values are two-sided and results are deemed statistically significant at $p < 0.05$.

RESULTS

A total of 686 children were assessed for eligibility and 128 were excluded as they met the exclusion criteria. The remaining 558 children were randomised into interactive animated video group (n = 277) and combined animated videos group (n = 281). The patient recruitment flowchart is illustrated in Fig. 1.

Demographic variables including age, gender and race were comparable between the two intervention groups. The groups were also similar in regards to scan-related details including prior MRI experience, requirement for intravenous contrast and scan duration. In the interactive video group (n = 277), 86 (31.0%) children needed repeated MRI sequences, 2 (0.7%) needed GA, and the proportion of children who had confidence in staying still for greater than 30 minutes increased by 22.1% after watching the video. In the combined videos group (n = 281), 102 (36.3%) children needed repeated MRI sequences, 6 (2.1%) needed GA, and the proportion of children who had confidence in staying still for greater than 30 minutes increased by 23.2% after watching the videos (Table I).

Children needing required repeated MRI sequences (n = 188) showed significant differences in age ($p < 0.0001$) and gender ($p < 0.001$) compared to those who did not have a repeated MRI sequence (n = 370) (Table II). Logistic regression analysis showed that older children were less likely to have repeated MRI sequences (odds ratio (OR) = 0.86, 95% confidence interval (CI) = 0.81, 0.91, $p < 0.0001$), whereas male children were more likely to have a repeated or rescheduled scan (OR = 1.72, 95% CI = 1.18, 2.51, $p = 0.005$, Table III). Subgroup analysis on children needing rescheduling under GA was not performed due to small sample size (n = 8) (Table I).

Children aged 3 to 7 (n = 63) revealed no differences in repeated MRI sequences and GA between the two intervention groups. There was no significant increase in the proportion of children who had the confidence in staying still for greater than 30 minutes in the interactive video group ($p = 0.625$), whereas it was significantly increased by 17.7% in the combined videos group ($p = 0.031$). For children ages 8 to 12 (n = 224), there were no significant differences in the proportion of children having repeated MRI sequences ($p = 0.189$) and GA between the two groups. There were significant increases in the proportion of children who had the confidence in staying still for greater than 30 minutes in both groups ($p < 0.0001$). For children ages 13 to 20 (n = 271), there were no significant differences in the proportion of children having repeated MRI sequences ($p = 0.549$) and GA ($p = 0.322$) between the two intervention groups. There were significant increases in the proportion of children who had the confidence in staying still for greater than 30 minutes in both groups ($p < 0.0001$, Table IV).

Subgroup analysis was done to assess the effect of videos on different body regions being scanned. As most children came for a single MRI scan (n = 504), those who had multiple scans (n = 54) and therefore, longer scan duration were excluded from sub-group analysis. Regions such as head and neck (n = 6), abdomen (n = 17) and pelvis (n = 4) were too small for subgroup analysis. Patients who had special studies (n = 38) such as cardiac flow analysis, chest, brachial plexus and carotid vessels were also excluded from analysis. Brain scans refer to scans of the internal acoustic meatus, orbits, pituitary fossa and whole brain scan. Musculoskeletal scans refer to scans of the upper and lower extremities and the axial skeleton.

Since the majority of children required scans of the brain (n = 202) and the musculoskeletal system (n = 237), subgroup analysis were done for these two sub-groups. For children who had brain scans, there were no significant differences in the proportion of children having repeated

MRI sequences ($p = 0.571$) and GA ($p = 0.448$) between the two groups. There were significant increases in the proportion of children who had the confidence in staying still for greater than 30 minutes in both groups ($p < 0.001$). For children who had scans of the musculoskeletal system, there were no significant differences in the proportion of children having repeated MRI sequences ($p = 0.160$) and GA ($p = 0.179$) between the two groups. There were significant increases in the proportion of children who had the confidence in staying still for greater than 30 minutes in both groups ($p < 0.0001$). It was noted that brain scans had shorter scan durations compared to musculoskeletal scans. Brain scans also had higher proportions of children needing repeated MRI sequences as compared to musculoskeletal scans (Table V).

DISCUSSION

Demographic parameters (age, gender and race) and the outcome proportions in the present study were consistent with those reported in the previous paper, demonstrating an adequate randomisation process and lack of selection bias.[2] It was noted that there were less children who had prior MRI experience and needed contrast in the current study as compared to the previous study. The results of this randomised, non-inferiority trial revealed that the interactive animated video was overall as efficacious as showing two videos with both groups demonstrating comparable repeated MRI sequences and GA proportions, and overall increase in confidence level in staying still for at least 30 minutes.

Since this study recruited patients ages 3 to 20, we were able to identify the type of children who are more likely to get repeated imaging or GA. Children between ages 3 to 7 were more likely to be un-cooperative and hence needing repeated MRI sequences or GA. This was seen in the previous study[2] and is also an age range that is the focus of most studies in clinical studies that aim to improve children's cooperation.[5,9,12,13] It is understandable that this age range had the highest proportion of children needing repeated imaging or GA as they are still developmentally immature in their level of understanding. Some studies had to exclude children below the age of 7 or 8 as they utilised self-reported tools such as anxiety and stress symptom scales which may be difficult to comprehend for younger children.[14,15] Therefore, more research should be done to evaluate the best pre-procedural intervention for children between 3 to 7 years old. Interestingly, the proportion of children ages 3 to 7 who did the scan under GA is lower in the current study as compared to the previous study. This could be due to increased awareness of staff about which children would be able to tolerate an MRI scan without GA.[16] In addition, a few parents in the current study had requested the anaesthesiologist to let their child try the scan without GA, thus lowering the incidence of GA in the current population. Although we have not explored the parents' intentions for attempting the scan without GA for their children, these parents could be more aware of and educated about the risks associated with GA.

Different body regions have different scan durations and some are prone to motion artefacts. By categorising children into different subgroups based on the region of the body being scanned, it was found that majority of children came for scans of the brain and the musculoskeletal system. The common indications for brain scans include headaches, seizures and follow up of brain malignancies. Whereas, common indications for musculoskeletal scans include injury, lumps and pain. In both subgroups, the interactive video group demonstrated non-inferiority to the combined videos group by showing comparable repeated MRI sequences and GA proportions, and similar increase in the proportion of children who are confident of staying still for at least 30 minutes. It was noted that despite the musculoskeletal scans having longer scan durations, there was a smaller proportion of children who needed repeated MRI sequences as compared to children who had brain scans. Children who had brain scans were younger than those undergoing musculoskeletal scans and could be anxious or frightened as their heads had to be confined inside a head coil, in addition to having to lie down inside the machine. The noise from the MRI machine could also be particularly loud for these children as the sequences used for brain imaging differ from musculoskeletal imaging. This was in contrast to musculoskeletal scans, in which the positioning of the patient was dependent on the region of interest and only the region of interest needs to be enclosed within the coil.

Pre-procedural preparation such as the use of interactive animated educational videos is important as it tells the patient what would happen and gives them an opportunity to experience what they would potentially feel during the procedure. This gives children the opportunity to rehearse the process of going through a medical procedure and helps them learn to cope with it. Anything a child may experience during the procedure can be rehearsed, however several pertinent points should be covered: the (1) duration and (2) location of the test, (3) the sequence of events, (4) sources of discomfort, (5) sensations that may be experienced and (6) how the child may feel when the procedure is done.[(17)] When exposed to such information, the patient would be able to mentally practise the impending stressful event, develop accurate expectations, and thereby manage better than those who have not thought about what is going to happen to them.

The use of pre-imaging interactive educational animated videos is a cost effective non-pharmacological intervention as it can be viewed repeatedly at any time and location. This is in contrast to the use of a life-sized MRI simulator which require space, manpower and expenditure costs.[(18)] It is, however, important to note that no single intervention alone is enough to help improve children’s cooperativity. Parental involvement, pre-procedural interventions and the use of distractions during the scan can all help to increase children's ability to cope with the procedure and increase level of satisfaction and confidence in children and their parents.

This study was not without limitations. As the videos were made in English, they would need to be reformatted for people who have no English literacy, or who have hearing or visual impairment. Young children may not be able to understand the concept of time and hence have difficulty answering questions regarding staying still for 30 minutes. The current sample size for children aged 3 to 7 is small and would benefit from a larger sample. The children were not blinded to their intervention group assignments and the outcomes observed could be due to placebo effects in those exposed to the videos.

We would like to evaluate the effect of increased video exposure such as viewing the video several times before the scan as information reinforcement could contribute to a larger effect than what was observed with the current one-time viewing. The ability and willingness of parents to help their children mentally rehearse the event and practice staying still for increasing lengths of time would have an effect on the results and we would need to capture these as well.

As the interactive video is currently formatted for the android tablet, the authors are interested in formatting it so that it's playable on the hospital's website which can be accessed on any type of electronic device such as the computer or the phone. The authors are also looking into creating videos for other imaging modalities such as ultrasound, fluoroscopy and nuclear medicine.

In conclusion, the interactive video is as efficacious as showing two videos in reducing of the proportion of children needing repeated magnetic resonance imaging sequences and increasing the proportion of children who had confidence in staying still for greater than 30 minutes.

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Fig. 1 Flowchart of patient selection.

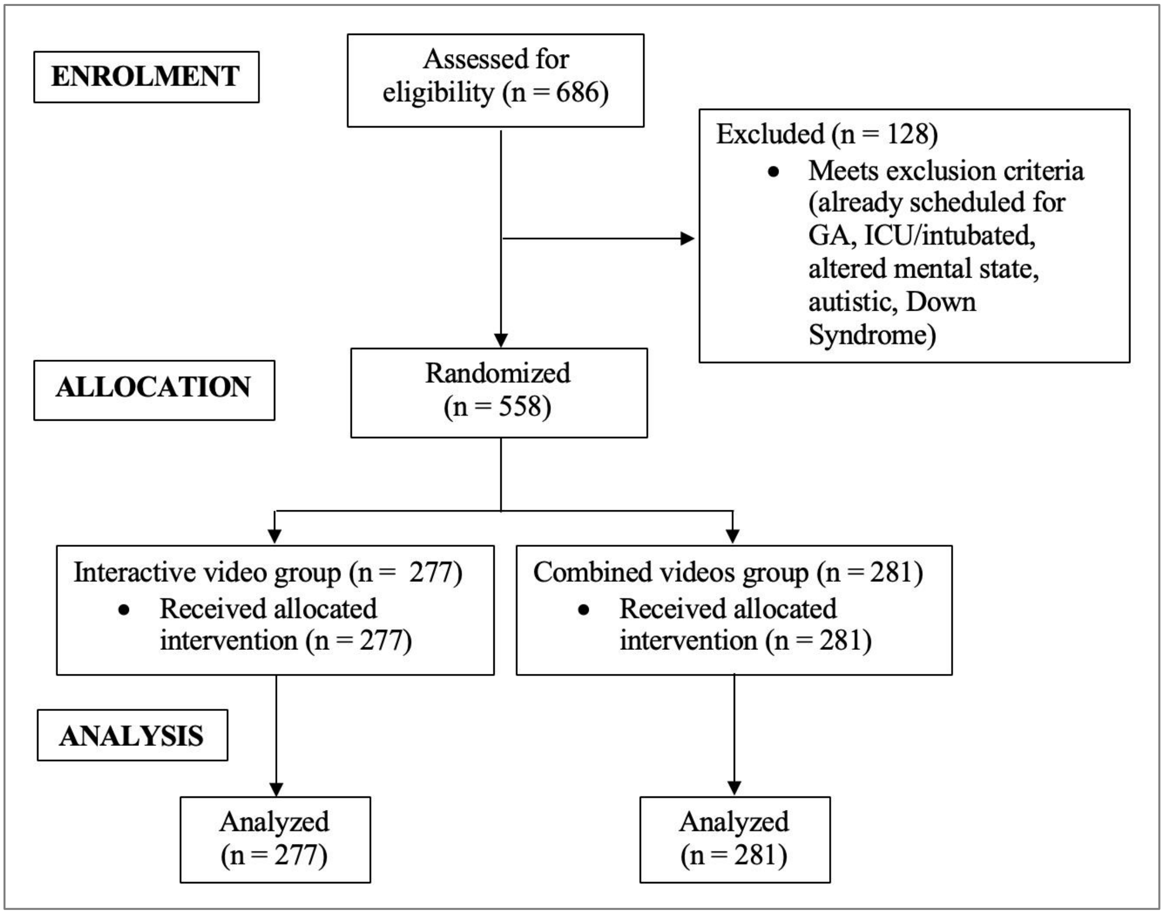

Table I Demographic variables and clinical features of interactive and combined video groups.

Variable		**Interactive Video (n = 277)**	**Both Videos (n = 281)**
		Mean ± SD/ Frequency (%)	**Mean ± SD/ Frequency (%)**
Age (years)		12.0 ± 3.26	11.8 ± 3.28
Gender	**Male**	138 (49.8)	136 (48.4)
	Female	139 (50.2)	145 (51.6)
Race	**Chinese**	184 (66.4)	193 (68.7)
	Malay	50 (18.1)	45 (16.0)
	Indian	33 (11.9)	29 (10.3)
	Others	10 (3.6)	14 (5.0)

Prior MRI experience		59 (21.3)	60 (21.4)
Required contrast		81 (29.2)	82 (29.2)
Scan Duration (min)		27:41 ± 9:54	28:15 ± 9:46
Outcomes			
Required repeated MRI sequences		86 (31.0)	102 (36.3)
Required GA		2 (0.7)	6 (2.1)
Confident of staying still for ≥ 30min	**Before video**	63 (22.7)	56 (19.9)
	After video	124 (44.8)	121 (43.1)

[a] Chi-square test for categorical variables, independent two-sample t-test for continuous variables. [b] McNemar's test for paired variable within each intervention group (confidence before vs after the intervention). *Abbreviations*: MRI = magnetic resonance imaging; GA = general anesthesia

Table II Comparison of children who required repeated MRI sequences due to motion artefacts and those who did not.

Variable		**Required repeated MRI sequences (n = 188)**	**Did not require repeated MRI sequences (n = 370)**	***p* value[a]**
		Mean ± SD/ Frequency (%)	**Mean ± SD/ Frequency (%)**	
Allocated Group	**Interactive Video**	86 (45.7)	191 (51.6)	0.189
	Both Videos	102 (54.3)	179 (48.4)	
Age (years)		10.8 ± 3.34	12.5 ± 3.08	<0.0001
Gender	**Male**	112 (59.6)	162 (43.8)	<0.001
	Female	76 (40.4)	208 (56.2)	
Race	**Chinese**	137 (72.9)	240 (64.9)	0.264
	Malay	25 (13.3)	70 (18.9)	
	Indian	19 (10.1)	43 (11.6)	
	Others	7 (3.7)	17 (4.6)	
Prior MRI experience		41 (21.8)	78 (21.1)	0.843
Required contrast		58 (30.9)	105 (28.4)	0.544
Scan Duration (min)		28:04 ± 11:30	27:55 ± 8:57	0.879

[a] Chi-square test for categorical variables, independent t-test for continuous variables.
Abbreviations: MRI = magnetic resonance imaging

Table III Summary of univariate and multivariable logistic regression analysis for repeated MRI sequence.

Variable		**Univariate**			**Multivariable[a]**		
		Odds Ratio (95% CI)	***p* value**	**Overall *p* value**	**Odds ratio (95% CI)**	***p* value**	**Overall *p* value**
Group	**Interactive vs Two Videos**	0.79 (0.556, 1.124)	0.190		0.828 (0.57, 1.204)	0.324	
Age		0.849 (0.802, 0.898)	<0.0001		0.859 (0.808, 0.913)	<0.0001	
Gender	**Male vs Female**	1.892 (1.325, 2.702)	<0.001		1.718 (1.175, 2.510)	0.005	
Race				0.269			0.537
	Malay vs Chinese	0.626 (0.379, 1.034)	0.067		0.732 (0.431, 1.246)	0.251	
	Indian vs Chinese	0.774 (0.434, 1.382)	0.386		0.824 (0.448, 1.516)	0.534	
	Others vs Chinese	0.721 (0.292, 1.783)	0.479		0.632 (0.246, 1.628)	0.342	
Prior MRI experience		1.044 (0.681, 1.600)	0.843		1.361 (0.831, 2.231)	0.221	
Required contrast		1.126 (0.768, 1.652)	0.544		0.78 (0.479, 1.271)	0.319	
Scan Duration		1.00003 (0.9997, 1.0004)	0.868		1.0002 (0.9998, 1.001)	0.378	

[a] Adjusted for allocated intervention group, age, gender, race, prior MRI experience, required intravenous contrast and scan duration.
Abbreviations: MRI = magnetic resonance imaging; CI = confidence interval

Table IV Demographic variables and clinical features of interactive and combined video groups by age groups

Variable		Interactive Video	Both Videos	*p* value[a]
		Mean ± SD/ Frequency (%)	Mean ± SD/ Frequency (%)	
Children from 3-7 years old		**n = 29**	**n = 34**	
Age (years)		6.07 ± 1.03	6.21 ± 0.98	0.591
Gender	**Male**	16 (55.2)	17 (50.0)	0.682
	Female	13 (44.8)	17 (50.0)	
Race	**Chinese**	21 (72.4)	27 (79.4)	0.449
	Malay	3 (10.3)	4 (11.8)	
	Indian	4 (13.8)	1 (2.9)	
	Others	1 (3.4)	2 (5.9)	
Prior MRI experience		3 (10.3)	3 (8.8)	0.838
Required contrast		14 (48.3)	11 (32.4)	0.198
Scan Duration (min)		28:41 ± 7:55	25:36 ± 11:21	0.305
Outcomes				
Required repeated MRI sequences		18 (62.1)	21 (61.8)	0.98
Required GA		2 (6.9)	5 (14.7)	0.326
Confident of staying still for ≥ 30min	**Before video**	4 (13.8)	3 (8.8)	0.625 (Interactive), 0.031 (Both)[b]
	After video	6 (20.7)	9 (26.5)	
Children from 8-12 years old		**n = 114**	**n = 110**	
Age (years)		10.2 ± 1.47	10.0 ± 1.46	0.375
Gender	**Male**	63 (55.3)	63 (57.3))	0.762
	Female	51 (44.7)	47 (42.7)	
Race	**Chinese**	75 (65.8)	76 (69.1)	0.740
	Malay	17 (14.9)	15 (13.6)	
	Indian	17 (14.9)	12 (10.9)	
	Others	5 (4.4)	7 (6.4)	
Prior MRI experience		27 (23.7)	23 (20.9)	0.618
Required contrast		36 (31.6)	34 (30.9)	0.914
Scan Duration (min)		27:04 ± 8:17	27:53 ± 9:50	0.496
Outcomes				
Required repeated MRI sequences		37 (32.5)	45 (40.9)	0.189
Required GA		0	0	-
Confident of staying still for ≥ 30min	**Before video**	21 (18.4)	18 (16.4)	< 0.0001[b]
	After video	45 (39.5)	47 (42.7)	
Children from 13-20 years old		**n = 134**	**n = 137**	
Age (years)		14.8 ± 1.36	14.6 ± 1.33	0.441

Gender	**Male**	59 (44.0)	56 (40.9)	0.599
	Female	75 (56.0)	81 (59.1)	
Race	**Chinese**	88 (65.7)	90 (65.7)	0.812
	Malay	30 (22.4)	26 (19.0)	
	Indian	12 (9.0)	16 (11.7)	
	Others	4 (3.0)	5 (3.6)	
Prior MRI experience		29 (21.6)	34 (24.8)	0.536
Required contrast		31 (23.1)	37 (27.0)	0.462
Scan Duration (min)		28:00 ± 11: 27	29:07 ± 9:17	0.383
Outcomes				
Required repeated MRI sequences		31 (23.1)	36 (26.3)	0.549
Required GA		0 (0)	1 (0.7)	0.322
Confident of staying still for ≥ 30min	**Before video**	38 (28.4)	35 (25.5)	< 0.0001[b]
	After video	73 (54.5)	65 (47.4)	

[a] Chi-square test for categorical variables, independent t-test for continuous variables.
[b] McNemar's test for paired variable within each intervention group (comparing confidence before vs after the intervention).
Abbreviations: MRI = magnetic resonance imaging; GA = general anesthesia

Table V Demographic variables and clinical features of interactive and combined video groups by the region of the body being scanned.

Variable		Interactive Video	Both Videos	*p* value[a]
		Mean ± SD/ Frequency (%)	Mean ± SD/ Frequency (%)	
Brain		**n = 111**	**n = 91**	
Age (years)		11.0 ± 3.28	10.4 ± 3.30	0.179
Gender	**Male**	68 (61.3)	51 (56.0)	0.453
	Female	43 (38.7)	40 (44.0)	
Race	**Chinese**	81 (73.0)	67 (73.6)	0.483
	Malay	15 (13.5)	11 (12.1)	
	Indian	13 (11.7)	8 (8.8)	
	Others	2 (1.8)	5 (5.5)	
Prior MRI experience		21 (18.9)	11 (12.1)	0.186
Required contrast		34 (30.6)	19 (20.9)	0.117
Scan Duration (min)		23:52 ± 6:51	22:30 ± 6:16	0.153
Outcomes				
Required repeated MRI sequences		42 (37.8)	38 (41.8)	0.571
Required GA		1 (0.9)	2 (2.2	0.448
Confident of staying still for ≥ 30min	**Before video**	18 (16.2)	16 (17.6)	< 0.001[b]
	After video	35 (31.5)	37 (40.7)	
Musculoskeletal		**n = 112**	**n = 125**	
Age (years)		12.8 ± 2.75	12.8 ± 2.89	0.892
Gender	**Male**	44 (39.3)	55 (44.0)	0.463
	Female	68 (60.7)	70 (56.0)	
Race	**Chinese**	67 (59.8)	86 (68.8)	0.530
	Malay	28 (25.0)	23 (18.4)	
	Indian	9 (8.0)	9 (7.2)	
	Others	8 (7.1)	7 (5.6)	
Prior MRI experience		15 (13.4)	21 (16.8)	0.466
Required contrast		19 (17.0)	26 (20.8)	0.452
Scan Duration (min)		28:19 ± 9:24	28:20 ± 8:38	0.99
Outcomes				
Required repeated MRI sequences		25 (22.3)	38 (30.4)	0.16
Required GA		0 (0)	2 (1.6)	0.179
Confident of staying still for ≥ 30min	**Before video**	26 (23.2)	25 (20.0)	< 0.0001[b]
	After video	58 (51.8)	56 (44.8)	

[a] Chi-square test for categorical variables, independent t-test for continuous variables.
[b] McNemar's test for paired variable within each intervention group (confidence before vs after the intervention). *Abbreviations*: MRI = magnetic resonance imaging; GA = general anesthesia