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Original Research

Effectiveness of public health practices against shaken baby syndrome/abusive head trauma in Japan

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ABSTRACT

Objectives: Previous studies have demonstrated the effectiveness of educational materials on infant crying to change caregivers' knowledge and behaviours related to shaken baby syndrome or abusive head trauma (SBS/AHT) using selected samples in randomized controlled trials. This study investigated the impact of public health practices to prevent SBS/AHT in Japan through the use of educational materials.

Study design: Cross-sectional study.

Methods: The intervention was comprised of two parts: (1) the screening of an educational DVD at a prenatal class; and (2) the distribution of a public health pamphlet at a postnatal home visit. Expectant parents watched a DVD (*The Period of PURPLE Crying*) about the features of infant crying and recommended behaviours (walking away if frustrated in the event of unsoothable crying, sharing information on crying with other caregivers) at a preterm parenting class held at eight months' gestation. A postnatal home-visit service was implemented in which a maternity nurse distributed a pamphlet to explain information about infant crying. Before the four-month health check-up, a self-administered questionnaire was distributed to assess exposure to these public health practices and outcome variables (i.e. infant crying knowledge, walk-away and information-sharing behaviours), and responses were collected at the four-month health check-up ($n = 1316$). The impacts of these interventions on outcome variables were analysed by comparing those exposed to both interventions, either intervention and neither intervention after adjusting for covariates.

Results: Crying and shaking knowledge were significantly higher among women exposed to the public health practices, with a dose-response relationship (both $P < 0.001$). Further, walk-away behaviour during periods of unsoothable crying was higher among the intervention group. However, sharing information about infant crying with other caregivers was less likely among the intervention group.

Conclusions: The impact of educational materials in public health practice on knowledge of crying and shaking, and walk-away behaviour in Japan had a dose-response relationship; however, an increase in sharing information with other caregivers was not observed.

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Introduction

Shaken baby syndrome or abusive head trauma (SBS/AHT) is the primary cause of death due to abuse in infants.[1] SBS/AHT is triggered by infant crying and is caused by the caregiver shaking the infant violently, with or without striking the infant against a hard surface. This can lead to serious head injuries such as subdural haematomas, diffuse axonal injury and retinal haemorrhage.

In Western countries, inflicted traumatic brain injury has an estimated rate of around 30 cases per 100,000 infants aged <12 months.[2,3] Although the prevalence rate of admitted SBS/AHT cases in Japan is unknown, it is estimated to be similar to rates in Western countries because the prevalence of shaking is similar: 2.6% for children <2 years old in North Carolina, USA,[4] 3.4% for infants aged six months in the Netherlands,[5] and 3.4% for infants aged four months in Japan.[6] The mortality rate ranges from 10% to 30%,[7–11] which is higher than that for *Haemophilus influenzae* type b meningitis (approximately 5%).[12] Significant neurological impairments are observed in at least 50% of SBS/AHT survivors.[13] The estimated cost of SBS/AHT is enormous; medical and long-term management costs have been reported to exceed $300,000 and $1,000,000 per case, respectively.[14] Effective interventions for preventing SBS/AHT are required to save the lives of children and costs to society.

A previous hospital-based study demonstrated the effectiveness of parental educational programmes on the dangers of shaking, which reduced the incidence of SBS/AHT by 47%.[15] A new educational programme, *The Period of PURPLE Crying*,[16] was recently developed based on evidence which showed that infant crying is a common stimulus of shaking.[15,17–19] The programme defines different aspects of infant crying, and features key recommendations for caregivers about how to manage a crying infant.

The letters that make up the acronym 'PURPLE' stand for the following aspects of infant crying: the peak pattern of crying (P), unexpected crying (U), crying that is resistant to soothing (R), the infant's pained expression when crying (P), long-lasting cries (L), and evening clustering of crying (E). The PURPLE programme outlines three 'action steps' for managing a crying infant: (1) use the 'carry, comfort, walk and talk' approach to calm the baby; (2) if the crying intensifies or becomes too frustrating, the caregiver is encouraged to walk away, then return to check on the baby; and (3) never shake or hurt the baby. The PURPLE programme also describes SBS and its risks to the infant, and emphasizes the need for caregivers to share information from *The Period of PURPLE Crying* with other caregivers, including how to manage frustration, the dangers of shaking a baby, and action steps to manage infant crying.

The PURPLE programme has demonstrated consistent effectiveness including increased knowledge of crying and recommended behaviours for preventing SBS/AHT (e.g. walking away during unsoothable crying, sharing information with other caregivers) in randomized controlled trials (RCTs) in Seattle, USA,[20] Vancouver, Canada[21] and Greater Tokyo, Japan.[22] However, the effectiveness of this educational programme demonstrated by these RCTs may not be generalizable to other settings due to selection bias. Therefore, the effectiveness of these educational materials in public health practice in a general population must be confirmed.

Other educational materials to prevent SBS/AHT have been developed. These include the Take 5 Safety Plan for Crying, which focuses on beliefs about infant crying in New Haven, USA[23]; a short and simple educational intervention introduced shortly after childbirth in France[24]; and an educational programme for maternity nurses that incorporates a leaflet, video and signed statement for parents that acknowledges receipt of information in New York, USA.[25] These programmes were also implemented in hospitals; however, few studies focused on them as a public health strategy. As part of a public health campaign to prevent SBS/AHT in Ontario, Canada, a three-pronged approach was used including in-hospital education, a home-visit programme and a media campaign. This revealed that 6% of caregivers required education on infant crying during home visits.[26] Further, a short animation entitled 'Crying Baby/Shaking Your Baby is Just Not the Deal', featuring strategies on how to respond to a crying infant, has been used in health promotion campaigns in Australia,[27] but empirical evidence of its effectiveness has not been reported clearly.

In Japan, due to an increase in reported child abuse and maltreatment cases,[28] several maternal-child health policies addressing child maltreatment have been implemented at the municipal level, such as prenatal parental classes, the Home-Visit Service for Newborns (a home-visit service by public health nurses during the first month of life) and the Home-Visit Project for all Infants (a home-visit service by trained community staff before four months of age). For example, the municipal government of Kamagaya City in Chiba, Japan, has provided parental classes for primiparous parents and interested parents, the Home Visit Service for Newborns for expectant parents, and the Home Visit Project for all Infants classes for all new mothers. Using these opportunities, the authors assessed the effectiveness of using educational materials about infant crying and management in public health practice to prevent SBS/AHT. It was hypothesized that caregivers who received prenatal parental classes or postnatal home visits would increase their knowledge and change their behaviours related to SBS/AHT compared with caregivers who were not exposed to these interventions, and effectiveness would be strongest among those who received both interventions. As public health practice in Japan promotes the provision of equal health services for all residents, an RCT was not a suitable design for this study; instead, an observational study design was used.

This study investigated the impact of newly developed public health practices to prevent SBS/AHT using educational materials on infant crying to increase knowledge and change behaviours related to SBS/AHT in Japan.

Methods

Sample

The target subjects were mothers ($n = 1594$) with infants aged four months between June 2010 and January 2012 (i.e. they were invited for the four-month health check-up during this period) in Kamagaya City, Chiba Prefecture. Kamagaya City is

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located in a suburban area north-west of Chiba City, with an approximate population of 108,000 and approximately 1000 births per year. A questionnaire assessing exposure to interventions as well as knowledge and behaviours about infant crying was mailed directly to the target population before the four-month health check-up, and the responses were collected during the health check-up. In total, 1334 completed questionnaires were obtained (response rate 84%). Participants who responded to questions about public health practices [i.e. intervention exposure ($n = 1316$)] were included in this study.

Participants were divided into three groups on the basis of exposure to public health practices: (1) not exposed to either intervention ($n = 179$, 13.6%); (2) exposed to either the prenatal parental class (i.e. watched DVD only, $n = 16$) or the public health home-visit service (i.e. received explanation on infant crying and pamphlet only, $n = 790$); and (3) exposed to both interventions ($n = 331$, 25.2%).

Intervention

The intervention was composed of two parts. The first part was the screening of the DVD, '*The Period of PURPLE Crying*',[16] at a prenatal parental class. Primiparous parents and other interested parents joined the class at approximately eight months of gestation.

The second part of the intervention was performed during a postnatal home visit (i.e. the Home-Visit Service for Newborns and/or Home-Visit Project for All Infants) when a public health nurse distributed a pamphlet to explain different aspects of infant crying and how to manage a crying infant. The pamphlet was 12 pages in length and entitled 'Mother, Crying is a Baby's Work'. It explained the features of infant crying, such as peaks of crying and the existence of unsoothable crying, and how best to deal with crying (e.g. feeding, nappy changing, holding, walking away during unsoothable crying). The pamphlet also emphasized that the caregiver must never shake the infant, and it recommended that participants should share information on infant crying and management with other caregivers. Parts of the pamphlet were adapted for a Japanese audience (e.g. Japanese-style tables and tea were included in illustrations that showed the importance of taking a short break at times when infant crying caused stress to the caregiver).

In Kamagaya City, participants who received the Home-Visit Service for Newborns were those who elected to receive this service before their newborn was one month old. All new mothers received the Home-Visit Project for All Infants, and were visited by trained community staff from 2007 until the infant was four months old. Information about exposure to the interventions (i.e. whether women participated in the prenatal parental class and/or received public health home visits) was gathered using the questionnaire at the four-month health check-up.

Outcome measures

Questions about crying and shaking knowledge used in previous studies[20–22] were included in the questionnaire administered at the four-month check-up. Eight questions assessed knowledge of infant crying properties (e.g. 'Infant crying increases in the first few weeks of life and reaches a peak in the first 2 or 3 months before decreasing'). Four Likert-type response options were given ('strongly agree,' 'agree,' 'disagree' and 'strongly disagree') and were assigned values of 0–3, respectively, where the correct answer was denoted by a higher score. Only two statements assessing knowledge of shaking ['Shaking an infant can cause serious health problems or even death' and 'Shaking a baby is a good way to help a baby stop crying' (reverse coded)'] were included in order to reduce the volume of the questionnaire. The responses were scored in the same way as those for infant crying. The sum of scores for each scale was transformed to a range of 0–100, where higher scores suggested better knowledge.

Recommended behaviours that were outlined in the educational materials (e.g. walking away during unsoothable crying, sharing information on infant crying with other caregivers) and frequency of behaviours were also assessed in the questionnaire at the four-month check-up. Frequency during the past month was assessed with response items of '0 times', '1–2 times', '3–5 times', '6–10 times' and '11 or more times'.

Sharing information on infant crying with other caregivers refers to the practice of sharing information acquired from educational materials on infant crying, such as the peak pattern of crying or walk-away behaviours, with other caregivers who were not exposed to the DVD or pamphlet. For example, women may share this information with their partners or parents after receiving the intervention. Most interventions to prevent SBS/AHT only reach mothers, and as evidence shows that most perpetrators of SBS/AHT are male caregivers,[29] information-sharing behaviour is important in order to reach other caregivers in the family, especially male caregivers.

Covariates

As public health practices cannot be allocated randomly, information about infant characteristics (i.e., infant age, sex, whether the baby is the mother's first baby, birth weight, feeding type), maternal characteristics (i.e. education, having someone to consult with on infant care, having someone to help with infant care) and family characteristics (i.e. marital status, living with grandparents, co-sleeping, housing type, annual household income) was collected in the questionnaire at the four-month check-up in order to adjust background characteristics between groups.

Furthermore, to adjust for unequal distributions, the following aspects were also assessed in the questionnaire at the four-month check-up: having a baby that cries a lot; perception of crying; recognition of crying; and stress due to crying. Perception of crying was assessed using the statement 'My baby cries a lot' with a five-part Likert scale ranging from 1 ('Not at all') to 5 ('Yes, a lot'). Stress due to crying was assessed using the statement 'I feel stressed due to infant crying' and the same scale. Positive and negative recognition of infant crying were also measured. Positive recognition was assessed by responses to two statements: 'When the infant is crying intensely, I think it is a good sign of development' and 'I think intense infant crying is an aspect of the infant's personality', which included a four-item Likert scale with good internal

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validity (Cronbach's $\alpha = 0.71$) comprised of 'never', 'rarely', 'sometimes' and 'always'. Negative recognition was assessed using seven statements (e.g. 'I am anxious about bothering neighbours when my infant is crying a lot' or 'I feel like I'm a bad mother when my infant is crying a lot') using the same four-item Likert scale with good internal validity (Cronbach's $\alpha = 0.73$). The sum of scores from each scale was transformed to a range of 0–100.

Ethics

This study was approved by the Ethics Committee of the National Institute for Public Health (NIPH-IBRA #10001), which determined that response to the questionnaire implied consent to participate in the study.

Analysis

First, linear regression analysis was performed to analyse associations between exposure level and perceptions of crying, recognition of crying, stress due to crying and knowledge of crying using crude and covariate-adjusted models. Model 1 adjusted for infant age, sex, birth weight, feeding type, maternal education, having someone to consult/help with infant care, marital status, living with grandparents, co-sleeping status, housing type and annual household income. Further, Model 2 adjusted for Model 1 plus crying-related variables (perception of crying, negative and positive recognition of crying, stress due to crying) to determine the possible mediation of crying-related variables on recommended behaviours among both or either intervention groups.

Second, the distributions of recommended behaviours (e.g. walking away during unsoothable crying, sharing information with other caregivers) were analysed for each group using the Chi-squared test.

Furthermore, on the basis of these distributions, walking away and sharing information with other caregivers were treated as ordinal outcomes, and odds ratios of recommended behaviours for exposure to an intervention in comparison with non-exposure were analysed using ordered logistic regression in the crude model. Covariates were adjusted for Models 1 and 2. Model 1 was adjusted for possible confounders (i.e. infant, maternal and family characteristics), and Model 2 was adjusted for confounders plus crying-related variables as possible mediators (i.e. perception of crying, recognition of crying, stress due to crying, crying and shaking knowledge). All analyses were conducted using Stata/MP Version 12.0 (Stata Corp., College Station, TX, USA).

Results

Participants' characteristics are listed in Table 1. Chi-squared tests showed several differences between groups: all women exposed to interventions had a higher level of education ($P < 0.001$) and were less likely to have someone who could help them with infant care ($P = 0.075$) compared with women who were not exposed to either of the interventions; and, as expected, women exposed to both interventions were more likely to be having their first baby ($P < 0.001$). In contrast, mothers who were not exposed to either of the interventions were more likely to be bottle feeding their infant ($P = 0.016$), living with grandparents ($P = 0.002$), co-sleeping ($P = 0.024$) and living in a detached house ($P < 0.001$). The distribution of low-birthweight infants was higher among mothers exposed to both interventions (12.1%), followed by mothers exposed to neither intervention (11.2%) and mothers exposed to one intervention (8.8%). Characteristics such as maternal age, having someone to consult with on infant care, age and sex of the infant, marital status and annual household income did not differ between exposure groups. Interestingly, 41.7% of mothers who were not exposed to either of the interventions reported that they read the pamphlet at least once, suggesting the contamination of pamphlet exposure.

Scores for perception of crying, recognition of crying, stress due to crying and knowledge of crying by group are compared in Table 2 with Models 1 and 2. Perception of crying did not differ between groups. Positive recognition of crying was significantly higher among women exposed to both or either intervention, with a dose-response relationship ($P = 0.015$), although this became marginal after adjusting for covariates ($P = 0.072$). However, negative recognition of crying was also higher among women exposed to both or either intervention, even after adjusting for covariates ($P = 0.005$). Stress due to crying was higher among women exposed to both or either intervention, but became non-significant after adjustment. Crying and shaking knowledge were significantly higher among women exposed to both or either intervention; both remained significant after adjusting for confounders (Model 1, both $P < 0.001$) and mediators (Model 2, both $P < 0.001$).

Table 3 shows distributions of recommended behaviours among groups, and comparisons according to the Chi-squared test. Walking away during unsoothable crying was a more common behaviour among mothers exposed to both or either intervention ($P = 0.038$), although sharing information with other caregivers did not differ significantly between groups.

Table 4 shows the impact of interventions on recommended behaviours using ordered logistic regression modelling, where Model 1 was adjusted for covariates and Model 2 was adjusted for covariates plus crying variables. Compared with women who were not exposed to either of the interventions, women exposed to both or either intervention were 1.79 [95% confidence interval (CI) 1.23–2.61] and 1.48 (95% CI 1.05–2.08) times more likely to walk away during unsoothable crying, which remained significant after adjusting for infant, maternal and family characteristics in a dose–response manner [adjusted odds ratios: 1.91 (95% CI 1.25–2.92) and 1.58 (95% CI 1.11–2.26), respectively]. Interestingly, the association became non-significant after including mediators (i.e. perception of crying, recognition of crying, stress due to crying, knowledge of crying). Further, although sharing information with other caregivers was not associated in the crude model or Model 1, women exposed to both interventions were less likely to share information with other caregivers than women who were not exposed to either intervention [adjusted odds ratio 0.55 (95% CI 0.37–0.83)].

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Table 1 – Characteristics of sample.

			Intervention exposure						P-value for Chi-squared test
			Both interventions (n = 331, 25.2%)		One intervention (n = 806, 61.3%)		Neither intervention (n = 179, 13.6%)		
			n	%	n	%	n	%	
Infant characteristics	Age (weeks)	<19	59	17.8	165	20.5	29	16.2	0.20
		19–21	174	52.6	449	55.7	110	61.5	
		≥22	95	28.7	182	22.6	37	20.7	
		Missing	3	0.9	10	1.2	3	1.7	
	Sex	Male	174	52.6	420	52.1	77	43.0	0.09
		Female	157	47.4	382	47.4	102	57.0	
		Missing	0	0.0	4	0.5	0	0.0	
	First baby	Yes	289	87.3	318	39.5	40	22.4	**<0.001**
		No	42	12.7	485	60.2	139	77.7	
		Missing	0	0.0	3	0.4	0	0.0	
	Birth weight (g)	<2500	290	87.6	715	88.7	156	87.2	0.06
		≥2500	40	12.1	71	8.8	20	11.2	
		Missing	1	0.3	20	2.5	3	1.7	
	Feeding type	Breastfeeding only	152	45.9	378	46.9	81	45.3	**0.016**
		Mixed	120	36.3	251	31.1	43	24.0	
		Bottle only	58	17.5	170	21.1	54	30.2	
		Missing	1	0.3	7	0.9	1	0.6	
Maternal characteristics	Education	High school or less	76	23.0	266	33.0	84	46.9	**<0.001**
		Some college	161	48.6	350	43.4	60	33.5	
		College or more	91	27.5	181	22.5	30	16.8	
		Missing	3	0.9	9	1.1	5	2.8	
	Having someone to consult with on infant care	Yes	271	81.9	670	83.1	147	82.1	0.53
		No	59	17.8	128	15.9	29	16.2	
		Missing	1	0.3	8	1.0	3	1.7	
	Having someone to help with infant care	Yes	224	67.7	601	74.6	137	76.5	0.075
		No	105	31.7	196	24.3	40	22.4	
		Missing	2	0.6	9	1.1	2	1.1	
Family characteristics	Marital status	Married	329	99.4	791	98.1	173	96.7	0.10
		Never married or divorced	2	0.6	12	1.5	6	3.4	
		Missing	0	0.0	3	0.4	0	0.0	
	Living with grandparents	Yes	20	6.0	95	11.8	27	15.1	**0.002**
		No	311	94.0	711	88.2	152	84.9	
	Co-sleeping	Yes	147	44.4	437	54.2	98	54.8	**0.024**
		No	181	54.7	358	44.4	80	44.7	
		Missing	3	0.9	11	1.4	1	0.6	
	Housing type	Apartment	196	59.2	387	48.0	77	43.0	**<0.001**
		Detached house	132	39.9	416	51.6	97	54.2	
		Missing	3	0.9	3	0.4	5	2.8	
	Annual household income (million yen)	<4	93	28.1	253	31.4	70	39.1	0.33
		4.1–6	123	37.2	283	35.1	47	26.3	
		6.1–8	50	15.1	123	15.3	29	16.2	
		≥8	25	7.6	57	7.1	11	6.2	
		Missing	40	12.1	90	11.2	22	12.3	
Exposure to intervention	PURPLE DVD	Yes	204	61.6	13	1.6	1	0.6	**<0.001**
		No	127	38.4	787	98.4	174	99.4	
	Pamphlet	Not read	23	7.0	119	15.1	81	50.3	**<0.001**
		Read some	12	3.7	49	6.2	13	8.1	
		Read once	209	63.5	478	60.8	60	37.3	
		Read several times	85	25.8	140	17.8	7	4.4	

*Bold signifies $p < 0.05$.

Discussion

The results of this study demonstrated that public health practice for SBS/AHT prevention using educational materials on knowledge and behaviours had a dose-response relationship. However, sharing information with other caregivers did not show higher odds among the intervention group. These findings suggest that public health practices, such as prenatal classes and home-visit programmes, using

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Table 2 – Comparison of perception of crying, recognition of crying, stress due to crying and knowledge of crying among all groups using linear regression models.

		Intervention exposure					
		Both interventions	One intervention	Neither intervention	P for trend		
		Mean (SD)	Mean (SD)	Mean (SD)	Crude	Model 1	Model 2
Perception of crying	'My baby cries a lot' [range: 1 (not at all) to 5 (yes, a lot)]	2.60 (1.19)	2.52 (1.15)	2.62 (1.16)	0.94	0.064	
Recognition of crying	Positive recognition (two items, score range 0–100)	42.4 (24.3)	41.4 (23.5)	36.4 (24.6)	**0.015**	0.072	
	Negative recognition (seven items, score range 0–100)	27.7 (13.8)	25.0 (13.0)	21.4 (12.4)	**<0.001**	**0.005**	
Stress due to crying	'Feel stress due to crying' [range: 1 (not at all) to 5 (always)]	2.21 (0.91)	2.04 (0.89)	1.94 (0.89)	**0.001**	0.29	
Knowledge of crying	Crying knowledge (eight items, score range 0–100)	61.5 (11.2)	56.4 (10.1)	52.7 (9.9)	**<0.001**	**<0.001**	**<0.001**
	Shaking knowledge (two items, score range 0–100)	85.8 (17.4)	79.8 (19.1)	77.4 (20.6)	**<0.001**	**<0.001**	**<0.001**

Model 1 was adjusted for infant age, sex, birth weight, feeding type, maternal education, having someone to consult/help with infant care, marital status, living with grandparents, co-sleeping status, housing type and annual household income.
Model 2 was adjusted for Model 1 plus perception of crying, recognition of crying (both negative and positive) and stress due to crying.
*Bold signifies $p < 0.05$.

educational materials on infant crying were effective for improving crying and shaking knowledge and walk-away behaviours, but did not change information-sharing behaviours.

The present results are consistent with those of previous RCTs of the educational programme, *The Period of PURPLE Crying*, in that crying knowledge and walk-away behaviours were higher among women exposed to educational material.[20–22] Moreover, the present study population exhibited a greater difference in increased crying knowledge compared with the previous RCTs. This suggests that the interventions had a stronger effect on increasing crying knowledge in the present population-based study, which covered a wider range of women than the previous RCTs.

An RCT study in Japan published in 2012 showed that walk-away behaviours were 4.77 times more common among women who were exposed to PURPLE crying material compared with control groups,[22] which is a much higher rate ratio than the present study. This difference may be due to different methods of measuring; the 2012 RCT used a diary and counted the instances of actual walk-away behaviours,[22] whereas the present study relied on a questionnaire, which may have led to recall bias. However, the present study suggested that crying properties (e.g. crying and shaking knowledge) mediated walk-away behaviours, which in turn highlights the pathway of how educational material affects walk-away behaviour during unsoothable crying.

This study also confirmed that the public health practices had a dose-response effect, as the combination of the prenatal parental class and home-visit service had a stronger impact than exposure to one intervention. This was consistent with the dose-response effect of exposure to *The Period of PURPLE Crying* programme in previous RCTs.[20–22] Thus, the combination of the prenatal parental class and public health home visits might be a feasible method for preventing SBS/AHT. However, further study is required to confirm if more frequent exposure to educational materials within current public health practice, such as showing a DVD and providing a pamphlet during home visits, has a stronger effect.

Although previous RCTs did not show any difference with respect to shaking knowledge,[20–22] this study showed that women exposed the public health practices had significantly greater knowledge of shaking. This may be important because the participants of previous RCTs might be limited to those who are interested in infant care, which may have led to a ceiling effect on shaking knowledge. As this study was a population-based study, participants who were not interested in childcare were included, and therefore showed a lower level of shaking knowledge than average, which changed significantly as a result of the intervention.

Previous RCTs in Japan[22] reported non-significant increases in sharing information about infant crying with other caregivers; however, this study found significantly fewer sharing behaviours among women exposed to the public health practices. This difference may be due to differences in background characteristics; women exposed to both interventions participated in the prenatal parental class with

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Table 3 – Distribution of recommended behaviours among all groups.

		Intervention exposure						*P* for Chi-squared test
		Both interventions		One intervention		Neither intervention		
		n	%	*n*	%	*n*	%	
Walk away during unsoothable crying	0 times	124	55.6	490	61.0	184	69.7	**0.038**
	1–2 times	35	28.1	190	23.7	93	19.7	
	≥3 times	19	16.3	123	15.3	54	10.7	
Sharing information about infant crying	0 times	92	28.0	273	34.4	60	34.3	0.31
	1–2 times	121	36.8	264	33.3	56	32.0	
	≥3 times	116	35.3	257	32.4	59	33.7	

*Bold signifies $p < 0.05$.

their husbands and were less likely to live with grandparents, which suggests that women exposed to both interventions may not have had someone to share the information with. Further study is needed to elucidate the barriers preventing women from sharing information about infant crying with other caregivers.

This study has several limitations. First, exposure to interventions was not assigned at random. Those who attended the prenatal parental class included primiparous parents and other parents willing to join the class. However, some of these participants refused to participate in the home-visit programme, despite the fact that all women were supposed to receive this intervention. This suggests that women in the intervention groups are more likely to be concerned about infant care, as the intervention groups showed a relatively higher percentage of participants who did not have someone to help them with infant care, and had higher levels of education (Table 1). Further, although this study adjusted for known covariates, unmeasured confounding factors such as childhood abuse history may have influenced associations,[30] which can be remedied by RCTs. However, as public health services should be provided to those who wish to receive them, an RCT design was not feasible to investigate the effectiveness of public health practice to prevent SBS/AHT in this setting.

Second, as exposure to the intervention was self-reported, some participants may have been misclassified during group allocation. Third, walk-away behaviours were self-reported and not based on objective measurements such as video recordings or diary records, which may have induced recall bias. Fourth, although this was a population-based survey, not all participants responded to the survey, and the demographic difference between participants and non-participants was unknown. Fifth, although parity was controlled, prenatal differences in crying knowledge and walk-away behaviours may initially be higher among the intervention groups. Further research is needed to measure knowledge and behaviours related to SBS/AHT before and after the intervention in order to compare the pre–post change between the intervention and control groups.

Despite these limitations, the present results indicate that public health practice in Japan to prevent SBS/AHT using educational materials on infant crying increased both knowledge of crying and shaking, and walk-away behaviours, which are both important in reducing SBS/AHT. Additional population-based prevention studies involving greater exposure of educational materials are required to demonstrate the actual impact of such interventions on the incidence of SBS/AHT.

In conclusion, women exposed to public health practices (i.e. prenatal parental classes and postnatal home-visit services) in Japan using educational materials (DVDs and pamphlets) on infant crying and the dangers of shaking had significantly greater knowledge of crying and shaking, as well as walk-away behaviours, to manage unsoothable crying after the intervention. A dose-response relationship was observed for exposure to the public health practices. In future, a more intensive intervention programme is required for stronger impacts on crying-related knowledge and behaviours, and ultimately an actual reduction in SBS/AHT.

Table 4 – Odds ratios of recommended behaviours to prevent abusive head trauma among all groups using ordered logistic regression.

		Intervention exposure			
		Both interventions	One intervention	Neither intervention	*P* for trend
Walk away during unsoothable crying	Crude	**1.79 (1.23–2.61)**	**1.48 (1.05–2.08)**	ref	**0.003**
	Model 1	**1.91 (1.25–2.92)**	**1.58 (1.11–2.26)**	ref	**0.005**
	Model 2	1.51 (0.95–2.39)	1.34 (0.92–1.95)	ref	0.097
Sharing information about infant crying	Crude	1.19 (0.85–1.67)	0.97 (0.71–1.31)	ref	0.18
	Model 1	0.68 (0.46–1.00)	0.82 (0.60–1.13)	ref	**0.049**
	Model 2	**0.55 (0.37–0.83)**	**0.72 (0.52–0.99)**	ref	**0.004**

Model 1 was adjusted for infant age, sex, birth order, birth weight, feeding type, maternal education, having someone to consult/help with infant care, marital status, living with grandparents, co-sleeping status, housing type and annual household income.
Model 2 was adjusted for Model 1 plus perception of crying, recognition of crying (both negative and positive) and stress due to crying.
*Bold signifies $p < 0.05$.

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Author statements

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Ethical approval

This study was approved by the Ethics Committee of the National Institute for Public Health (NIPH-IBRA #10001).

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Competing interests

None declared.

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