

Effects of Individual Explanations by Midwives about the Process of Delivery, Using 3D Animation Software, on Parturient Females' Understanding of and Satisfaction with Delivery

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Abstract

Objectives: To clarify the effects on the delivery experience of midwives giving parturient females individual explanations about how the course of delivery, using 3D animation software (Delivery Animation). **Method:** 1) Subjects: Women admitted to Institution A for delivery; 70 in the intervention group (34 primipara, 36 multipara), and 79 (41 primipara, 38 multipara) in the control group. 2) Data collection method: Intervention group; 3) During phases 1 and 2 of delivery, after internal examinations, collaborative-researcher midwives gave parturient women explanations about the course of delivery, using tablets with the Delivery Animation software installed. This software was independently developed by the researchers. On postpartum day 1, the collaborative-researcher midwives distributed anonymous, self-administered questionnaires to the postpartum women. 4) During phases 1 and 2 of delivery, the course of delivery was explained using existing methods, and anonymous, self-administered questionnaires were distributed on postpartum day 1. 5) The intervention group and control group were compared using descriptive and inferential statistics, organized into primipara and multipara. **Results:** In the Understanding the Delivery Process category, primipara in the intervention group had significantly higher scores for “understood baby’s rotation” ($p < 0.01$) and “understood progress through delivery” ($p < 0.05$). In multipara, the intervention group scored significantly higher for “understood baby’s rotation” ($p < 0.01$). In the anonymous self-evaluation, primipara in the intervention group scored significantly higher in “midwife I could trust was by my

side” ($p < 0.01$). Opinions on the Delivery Animation were classified into 7 categories. In their evaluations of the Delivery Animation, 89.0% of primipara and 92.0% of multipara said it helped them understand the course of labor, and 85.0% of primipara and 86.0% of multipara said it helped them communicate with the doctor/midwife. **Conclusion:** The significant differences in understanding of the course of delivery seen between the intervention and control groups, the satisfaction scores on the “Self-evaluation scale for experience of delivery (abridged version)” questionnaire, opinions about and evaluation of the Delivery Animation all show that a personal explanation of the course of childbirth has a positive effect on the understanding and satisfaction of parturient women.

Keywords

Midwives, Childbirth, Delivery Animation Software

1. Introduction

1) Academic background of research

In Japan, the proportion of c-sections is on the rise, with over twice as many compared to 25 years ago. In 2017, the percentage at general hospitals was 26% [1]. This is a global trend, and a rise in c-sections can be seen in all OECD (Organisation for Economic Co-operation and Development) member countries [2]. Thus, the cooperation of medical professionals and expecting mothers in avoiding unnecessary c-sections is vital.

It is difficult for mothers and visiting family to visualize what is happening inside the pelvic region during delivery, having the mother play a role in planning and managing the deliver and understanding the situation leads to avoiding the risks of relying on a c-section.

In a study on the relationship between women’s image of childbirth during pregnancy and their feelings toward it, women with a positive image of childbirth showed higher confidence in relation to it, and higher confidence led to higher satisfaction in the five days following delivery [3]. In the interest of improving patient satisfaction, midwives must be ever aware of what their patients are feeling and able to provide the care they need at all times. The need for a foundation of research upon which to base this care has also been brought up [4].

From the above facts, we can expect that having midwives explain each individual step of labor will help the patient understand the process of childbirth and give them insight. Of the four elements of childbirth (birth canal, fetal health, expulsive force, state of mind), we can also expect it to have a positive effect on the patient’s state of mind. Additionally, the sharing of information between the medical professionals and the patient/family can be a great help in avoiding unnecessary c-sections and providing a safe and satisfactory delivery.

For example, sharing the current state of the delivery and predictions of how it will progress can prepare patients for sudden progression, and help them understand why certain management techniques and procedures are done when labor isn't proceeding as planned.

3D computer graphic materials have been developed in association with the topics of this study [5] [6], all of which are mainly educational materials geared toward specialists and students. Digital communication support tools using techniques similar to those in this study are being developed and used in clinics for patient education in many regions [7] [8]. However, there is no tool in development to aid mothers in visualizing the torrent of changes happening inside them during childbirth.

2) Purpose of research

To demonstrate the effect explanation from a midwife making use of 3D animation software has on birthing mothers' understanding of the process of childbirth and their satisfaction with their childbirth experience, by comparison with the control group.

3) Hypothesis

a) The level of understanding of the process of childbirth will be higher in the intervention group than in the control group.

b) The level of satisfaction with the experience of childbirth will be higher in the intervention group than in the control group.

4) Terms

Delivery Animation (**Figure 1**).

Delivery Animation is shown in **Figure 1**.

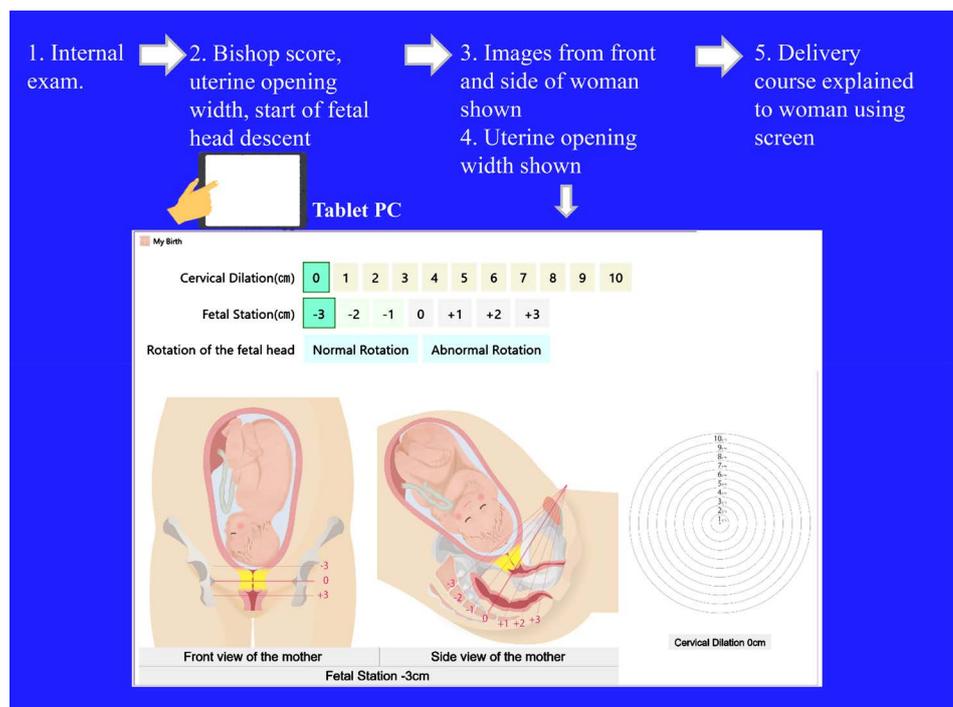


Figure 1. Delivery animation.

a) Definition

An independently developed software application used to display the pelvic region and explain the labor process. Pelvic exam data (cervical dilation, fetal station) is input using the Bishop score, which is a scale currently in use at routine clinics outside Japan, and corresponding images are displayed: frontal and lateral images of the mother's abdomen, dilation of the cervix, normal rotation, and abnormal rotation (occipitoposterior malposition).

b) Development process

i) The original idea was proposed among the researchers based on existing materials (obstetrics textbooks, reference books, etc.)

ii) An external animation specialist cooperated with the researchers to create the illustrations based on the original Delivery Animation idea.

iii) An external systems designer cooperated with the researchers to develop the software based on the Delivery Animation.

c) Software content

The details of the Delivery Animation software are as follows:

i) Input results of pelvic exam (dilation, fetal station)

ii) Display front and side images according to combination of values. Fetal station (front and side view of mother, 7 patterns from -3 to +3), and two patterns for rotation (normal and abnormal).

iii) Implemented function that enables the user to touch the screen to set zoom level.

iv) The software was installed on a Microsoft Surface Pro 3 tablet PC.

v) The system was designed in such a way that input cannot be recorded/saved.

2. Method of Research

1) Research design: Two-group cross comparative study

2) Survey period

a) April 2017 to August 2019

3) Research subjects

a) Intervention group: 70 women with an expected transvaginal birth at Gynecological Institution A at week 37 of gestation or later (34 primipara, 36 multipara).

b) Control group: 79 women with an expected transvaginal birth at Gynecological Institution A at week 37 of gestation or later (41 primipara, 38 multipara).

Using the statistical analysis software G*Power with a statistical significance of 0.05, detection quantity of 0.8, and detection strength of 0.8, the sample size was 27 subjects per group. Anticipating some subjects would drop out, we set the size of each group to be 40 subjects.

4) Inclusion Standards

a) Intervention group: women with an expected transvaginal birth at Gynecological Institution A at week 37 of gestation or later.

b) Control group: women with an expected transvaginal birth at Gynecological Institution A at week 37 of gestation or later.

5) Exclusion Standards

Judgement on whether to exclude subjects was decided by cooperative researchers (doctors and midwives).

a) At the time of referral to maternity ward/time of labor:

- i) age under 20 years.
- ii) premature birth.
- iii) planned C-section.

iv) Mothers/infants with adverse health conditions (gestational hypertension, multiple conception, fetal aplasia, abnormal amount of amniotic fluid, abnormal heartbeat in fetus, etc.).

v) Delivery preparations required immediately at time of hospitalization or other urgent cases.

vi) women whose participation would be difficult from a delivery management perspective.

b) Puerperium:

- i) Emergency C-section.
- ii) Mothers/infants with adverse health conditions (postpartum hemorrhage, puerperal fever, postpartum mental illness, deep-vein thrombosis, stillbirth, critical complications in newborn, etc.).

6) Data collection method (Figure 2).

a) Intervention group: Recruitment and procedure

i) At referral to maternity ward near end of pregnancy: Collaborative researchers (midwives) explain the study and hands out the instruction and consent forms.

ii) At time of labor in hospital: Collaborative researcher (midwife) requests

(April 2017 – April 2018)						
Intervention group data collection						
Time	Referral to maternity ward in final stages of pregnancy	At hospitalization for delivery	Delivery phases 1 to 2	During postpartum hospitalization Day 1, Day 3, Day 4/5		
Intervention Group	Request for study participation	Confirmation/Request of consent form	After gynecological exam, explanation of process with Delivery Animation	Questionnaire distributed	Questionnaire collected	Birth review
(May 2018 – August 2019)						
Control group data collection						
Time	Referral to maternity ward in final stages of pregnancy	At time of hospital admittance for labor	Delivery phases 1 to 2	During postpartum confinement Day 1, Day 3, Day 4/5		
Control Group	Request to participate in research	Confirmation/Request of consent form	After gynecological exam, oral explanation of process	Questionnaire distributed	Questionnaire collected	Birth review

Figure 2. Research protocol.

and confirms consent form.

iii) From first phase of delivery (contractions every 10 minutes until cervix is dilated) to second phase of delivery (from dilation of cervix until delivery of infant): Using a tablet computer with the Delivery Animation installed, the collaborative researcher (midwife) explains the progression of the birth.

iv) After a pelvic examination, the collaborative researcher (midwife) record the findings on a partogram recorded in the usual procedure.

v) Day 1 following delivery: The collaborative researcher (midwife) gives the subject an anonymous questionnaire. Responses are collected by having the subject insert the answer sheet in the attached envelope and drop it in a response box placed in a private area (in front of the nursery) by the day 3 after delivery.

vi) At time of discharge on day 4 or 5 after delivery: Collaborative researcher (midwife) performs a birth review as per the usual procedure.

vii) The head of research collects the responses.

b) Control group: Recruitment and procedure (held after completion of intervention group portion).

The procedure for the control group is the same as for the intervention group, with the exception of step iii. For this step, the collaborative researcher (midwife) explained the course of delivery orally, as per the usual procedure.

c) Data collected (**Table 1**)

i) Subject characteristics: Age, number of births, progression of current pregnancy

Table 1. Survey content.

Item	Content	Intervention	Control
Subject Characteristics	Age, number of deliveries, progression of current pregnancy. Multiplechoice.	•	•
Participation in maternity classes/ Sources of information about labor process	Participationin maternity classesregarding delivery, location, sources of information about process of delivery. Multiple choice.	•	•
Understanding of progression of labor	Dilation of cervix, descent of infant, rotation of fetus,time required for delivery, how water breaks when going into labor, changes in contractions. 4-level Likert scale from “Very knowledgeable” to “No knowledge”.	•	•
State of Delivery	Length of pregnancy, method of delivery, time required fordelivery, amount of blood loss during labor, infant birth weight, progress of newborn, presence of partner or other relative in delivery room. Multiple choice.	•	•
Understanding of delivery process following delivery	5-level Likert scale onthe understanding of the following items: cervical dilation, descent of infant, rotation of infant, breaking of water, and the course of labor. From “Strongly agree” to “Strongly disagree”.	•	•
Delivery self-evaluation(abridged)	18 items (7 labor pain coping skills, 6 items regarding trust of medical staff, 5 items concerning labor progression) on a 5-level Likert scale from “Strongly agree” to “Strongly disagree”.	•	•
Evaluation of Delivery Animation	5-level Likert scale from “Helpful” to “Not helpful at all”on if the animationwas helpful in understanding of the progression of labor, helpful in communicating with doctors/midwives.	•	
Opinions on Delivery Animation	Freeform response	•	

ii) Participation in maternity (parenting) classes, location, sources of information about childbirth.

iii) Understanding of process of childbirth: Created individually to gain an understanding of the baseline data. 4-level Likert scale from Very knowledgeable (4 points) to No knowledge (1 point) in the categories of cervical dilation, fetal descent, fetal rotation, time required for delivery, changes in contractions, how water breaks.

iv) State of delivery (entries in maternity passbook): Length of pregnancy, method of delivery, time required for delivery, amount of blood lost during labor, infant birth weight, progress of infant, presence of partner/relative in delivery room.

v) Understanding of process of childbirth: Created individually based on information presented in Delivery Animation. 5-level Likert scale from Strongly Agree (5 points) to Strongly Disagree (1 point) in the categories of cervical dilation, fetal descent, fetal rotation, how the water breaks, state of delivery (how far it has progressed).

Satisfaction with birth: Used the abridged self-evaluation scale [9]. Measured how satisfied subjects were with their experience giving birth. The 18 subscales (Labor pain coping skills: 7 items, Medical staff trust: 6 items, physiological process of labor: 5 items) were measured on a 5-level scale from Strongly Agree (5 points) to Strongly Disagree (1 point) and the total for all 18 items added together to obtain a total score (ranging from 18 - 90 points). A higher score represents higher satisfaction with the experience of childbirth. The reliability of the scale and the validity of the Self-Evaluation Scale for Experience of Delivery upon which the abridged version is based has been verified [9] [10].

vi) Evaluation of Delivery Animation: Rated on a 5-level Likert scale from Helpful (5 points) to Not helpful at all (1 point) in whether or not it was helpful in understanding the course of delivery and in communicating with doctor/midwife.

vii) Opinions about Delivery Animation (freeform response)

d) Method of analysis/evaluation (parturient): Statistical analysis used SPSS statistics 25 for Windows.

i) Statistics requested: Organized by primipara and multipara: subject characteristics, understanding of the course of childbirth during pregnancy, state of childbirth, understanding of the course of childbirth after delivery, Self-evaluation scale for experience of delivery (abridged version), evaluation of Delivery Animation.

ii) Statistical analysis performed. Compared the intervention group and control group, organized by primipara and multipara. χ^2 tests were performed on qualitative data, while t tests and Mann-Whitney tests were performed on quantitative data after verifying distribution. Significance level was below 5%.

iii) Opinions on the Delivery Animation were categorized and member checked in a qualitative descriptive manner.

3. Results

The state of distribution/collection is according to **Table 2**.

1) Subject characteristics

The number of subjects is shown in **Table 3**. The ratio of primipara to multipara in the two groups was nearly equal. Subject characteristics are shown in **Table 4**. The age range of 25 - 29 years was the largest for primipara in both groups, while the range of 30 - 34 years was the largest for multipara in both groups. The percentages of current pregnancies that were proceeding normally were 65.0% and 76.0% for primipara in the intervention and control groups, respectively; they were 81.0% and 63.0% for multipara in the intervention and control groups, respectively. The most common abnormality for both primipara and multipara was treatment for anemia. 13 primipara in the intervention group (38.0%) and 21 in the control group (51.0%) said they had participated in maternity (parenting) classes, while the overwhelming majority of multipara said they did not (33 multipara in the intervention group (92.0%) and 32 multipara in the control group (92.0%). Primipara in both groups often claimed the internet, friends/acquaintances, and childcare books/magazines as sources of information on the course of childbirth, while the most common sources claimed by multipara in both groups were internet and maternity checkup.

In primipara and multipara, no significant differences were observed in χ^2 test results for age, abnormality in pregnancy, or participation in maternity (parenting) classes between the control group and intervention group.

2) Understanding during pregnancy of course of childbirth (**Figure 3**)

Understanding during pregnancy of course of childbirth is shown in **Figure 3**.

For primipara, the highest proportions of very knowledgeable and some knowledge responses together were: “How contractions change” 64.7% for the intervention group and 68.3% for the control group and “Average duration of labor after contractions begin” 50.0% and 70.8% (intervention and control group, respectively). These were followed by: “How the cervix dilates during labor” (intervention 50.0%, control 53.7%); “How the infant descends the birth

Table 2. State of Distribution/Collection # of participants (%).

	Intervention	Control
#distributed	74 (100.0)	79 (100.0)
#collected (%)	70 (95.0)	79 (100.0)
#valid (%)	70 (95.0)	79 (100.0)

Table 3. Number of subjects.

	Intervention (n = 70)		Control (n = 79)		Total (n = 149)	
	Subjects	%	Subjects	%	Subjects	%
Primipara	34	45.3	41	54.7	75	100.0
Multipara	36	48.6	38	51.4	74	100.0

Table 4. Subject characteristics.

		Primipara (n = 75)						Multipara (n = 74)					
		Intervention (n = 34)		Control (n = 41)		χ^2 test		Intervention (n = 36)		Control (n = 38)		χ^2 test	
		#	%	#	%	Value	Sign. Diff.	#	%	#	%	Value	Sign. Diff.
Age	20 - 24	3	9.0	10	24.0			3	8.0	3	8.0		
	25 - 29	18	53.0	15	37.0			11	31.0	12	32.0		
	30 - 34	11	32.0	11	27.0	4.715	n.s.	15	42.0	14	37.0	5.721	n.s.
	35 - 39	2	6.0	5	12.0			6	17.0	9	24.0		
	40 - 44	0	0.0	0	0.0			1	3.0	0	0.0		
Progression of current pregnancy	Normal	22	65.0	31	76.0			29	81.0	24	63.0		
	Abnormal	11	32.0	10	24.0	0.719	n.s.	7	19.0	14	37.0	2.753	n.s.
	No response	1	3.0	0	0.0			0	0.0	0	0.0		
Breakdown of abnormalities (multiple responses)	Anemia	8	24.0	9	22.0			7	19.0	11	29.0		
	Threatened miscarriage	2	6.0	1	2.0			0	0.0	1	3.0		
	Threatened premature delivery	2	6.0	2	5.0			2	6.0	4	11.0		
	Other	1	3.0	1	2.0			0	0.0	1	3.0		
	Infant too large	1	3.0	0	0.0			0	0.0	0	0.0		
	Took labor suppressants	0	0.0	0	0.0			1	3.0	0	0.0		
Participation in maternity classes	No	21	62.0	19	46.0			33	92.0	35	92.0		
	Yes	13	38.0	21	51.0	1.506	n.s.	3	8.0	3	8.0	0.000	n.s.
	No response	1	3.0	1	2.0			0	0.0	0	0.0		
Sources of information regarding the process of childbirth	Maternity classes	8	24.0	14	34.0			4	11.0	2	5.0		
	Pregnancy checkup	14	41.0	18	44.0			20	56.0	23	61.0		
	Childcare books/magazines	20	59.0	20	49.0			14	39.0	11	29.0		
	Internet	25	74.0	22	54.0			20	56.0	21	55.0		
	Mother	16	47.0	18	44.0			12	33.0	8	21.0		
	Mother-in-law	5	15.0	6	15.0			1	3.0	3	8.0		
	Sister	7	21.0	10	24.0			5	14.0	1	3.0		
	Friend/Acquaintance	21	62.0	25	61.0			10	28.0	12	32.0		
Other	1	3.0	3	7.0			2	6.0	1	3.0			

n.s.: not significant.

canal” (intervention 41.1%, control 53.6%); “How the infant rotates during labor” (intervention 38.2%, control 46.4%); “How the water breaks” (intervention 20.6%, control 39.0%).

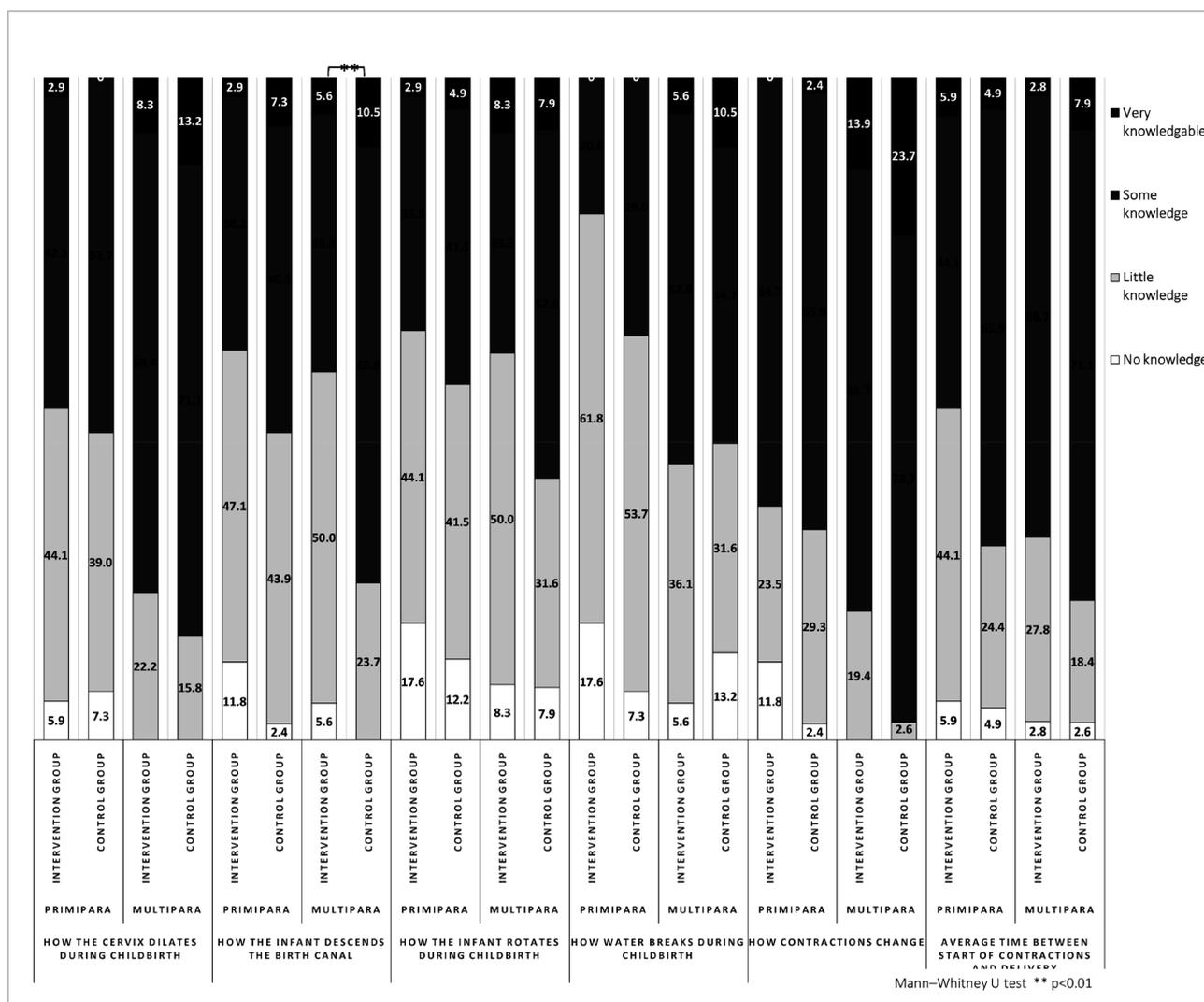


Figure 3. level of Knowledge of process of childbirth.

For multipara, the highest proportions were: “How contractions change” (intervention 80.6%, control 97.4%); “How the cervix dilates during labor” (intervention 77.7%, control 84.3%); “Average duration of labor after contractions begin” (intervention 69.5%, control 79.0%). These were followed by: “How the infant descends the birth canal” (intervention 44.5%, control 76.3%); “How the infant rotates during labor” (intervention 41.6%, control 60.5%); “How the water breaks” (intervention 58.4%, control 55.2%).

Comparison of the intervention and control groups revealed no significant differences among primipara. Among multipara, “How the infant descends the birth canal” was significantly higher ($p < 0.01$) in the control group.

3) State of delivery (Table 5)

State of delivery is shown in Table 5.

The methods of birth were divided into natural birth and non-natural births, non-natural births including induced labor, induced contractions, etc. The percentage of natural births was 38% and 22% for primipara, and 25% and 45% for

Table 5. State of subject delivery.

		Primipara(n = 75)				χ^2 test		Multipara(n = 74)				χ^2 test	
		Intervention (n = 34)		Control (n = 41)		Value	Sign. Diff.	Intervention (n = 36)		Control (n = 38)		Value	Sign. Diff.
		#	%	#	%			#	%	#	%		
Method of delivery	Natural birth	13	38.0	9	22.0	2.378	n.s.	9	25.0	17	45.0	3.160	n.s.
	Non-natural birth	21	62.0	32	78.0			27	75.0	21	55.0		
	Induced labor (metreurynters)	15	44.0	13	32.0			17	47.0	16	42.0		
	Induced labor (pill or IV)	14	41.0	16	39.0			16	44.0	15	39.0		
	Induced contractions mid-labor (pill or IV)	9	26.0	20	49.0			13	36.0	10	26.0		
	Vacuum extraction	11	32.0	15	37.0			2	6.0	28	74.0		
	Abnormal rotation of infant	1	3.0	2	5.0			1	3.0	4	11.0		
	Other	0	0.0	0	0.0			1	3.0	0	0.0		
Length of labor	Under 15 hours	27	79.0	33	80.0			32	89.0	38	100.0		
	15 - 30 hours	4	12.0	5	12.0	0.040	n.s.	2	16.0	0	0.0	0.637	n.s.
	Over 30 hours	2	6.0	2	5.0			0	0.0	0	0.0		
	No response	1	3.0	1	2.0			2	6.0	0	0.0		
Bleeding during labor	Small amount	22	65.0	28	68.0			27	75.0	32	84.0		
	Medium amount	6	18.0	8	20.0	0.093	n.s.	5	14.0	3	8.0	0.798	n.s.
	Large amount	3	9.0	3	7.0			2	6.0	2	5.0		
	No response	3	9.0	2	5.0			2	6.0	1	3.0		
Birth weight	Under 2500 g	2	6.0	1	2.0			1	3.0	0	0.0		
	2500 - 4000 g	32	94.0	39	95.0	1.382	n.s.	35	97.0	37	97.0	2.003	n.s.
	Over 4000 g	0	0.0	1	2.0			0	0.0	1	3.0		
Progress of infant	Under hospital supervision	34	100.0	41	100.0			35	97.0	37	97.0		
	No response	0	0.0	0	0.0			1	3.0	1	3.0		
Partner/ Relative	Present	23	68.0	28	68.0	0.004	n.s.	23	64.0	28	74.0	0.828	n.s.
	Not present	11	3.0	13	32.0			13	36.0	10	26.0		

n.s.: not significant.

multipara (intervention/control group respectively). The duration of labor for primipara was less than 15 hours for 79% for the intervention group and 80% for the control group; for multipara, this was 89% for the intervention group and 100% for the control group. The amount of bleeding was low for 65% of primipara in the intervention group (68% for the control group) and 75% of multipara in the intervention group (84% for the control group).

The birth weight between primipara, multipara, intervention group, and control group was between 2500 g and 4000 g. The vast majority of responses for

progress of infant were “Under hospital supervision”. 68% each of primipara for both groups had a partner or relative present in the delivery room, while for multipara this was 64% (intervention group) and 74% (control group).

In both primipara and multipara, no significant differences were observed in χ^2 test results between groups for delivery method, duration of labor, amount of bleeding during labor, birth weight, or presence of companion in delivery room between the intervention group and control group.

4) Understanding after viewing Delivery Animation (Figure 4)

Understanding after viewing Delivery Animation is shown in Figure 4.

For primipara, the highest proportions of Strongly Agree and Agree responses together were: “Understood dilation” (intervention 97.0%, control 92.0%); “Understood descent of infant” (intervention 94.1%, control 82.9%). These were followed by: “Understood my progress through delivery” (intervention 88.3%, control 80.5%); “Understood infant’s rotation” (intervention 85.3%, control 53.5%); “Understood how the water breaks” (intervention 67.7%, control 48.8%).

For multipara, the highest proportions were: “Understood dilation” (intervention 97.2%, control 97.4%); “Understood descent of infant” (intervention 94.5%, control 94.8%); “Understood my progress through delivery” (intervention 91.6%, control 97.4%); These were followed by: “Understood infant’s rotation” (intervention 91.6%, control 52.6%); “Understood how the water breaks” (intervention

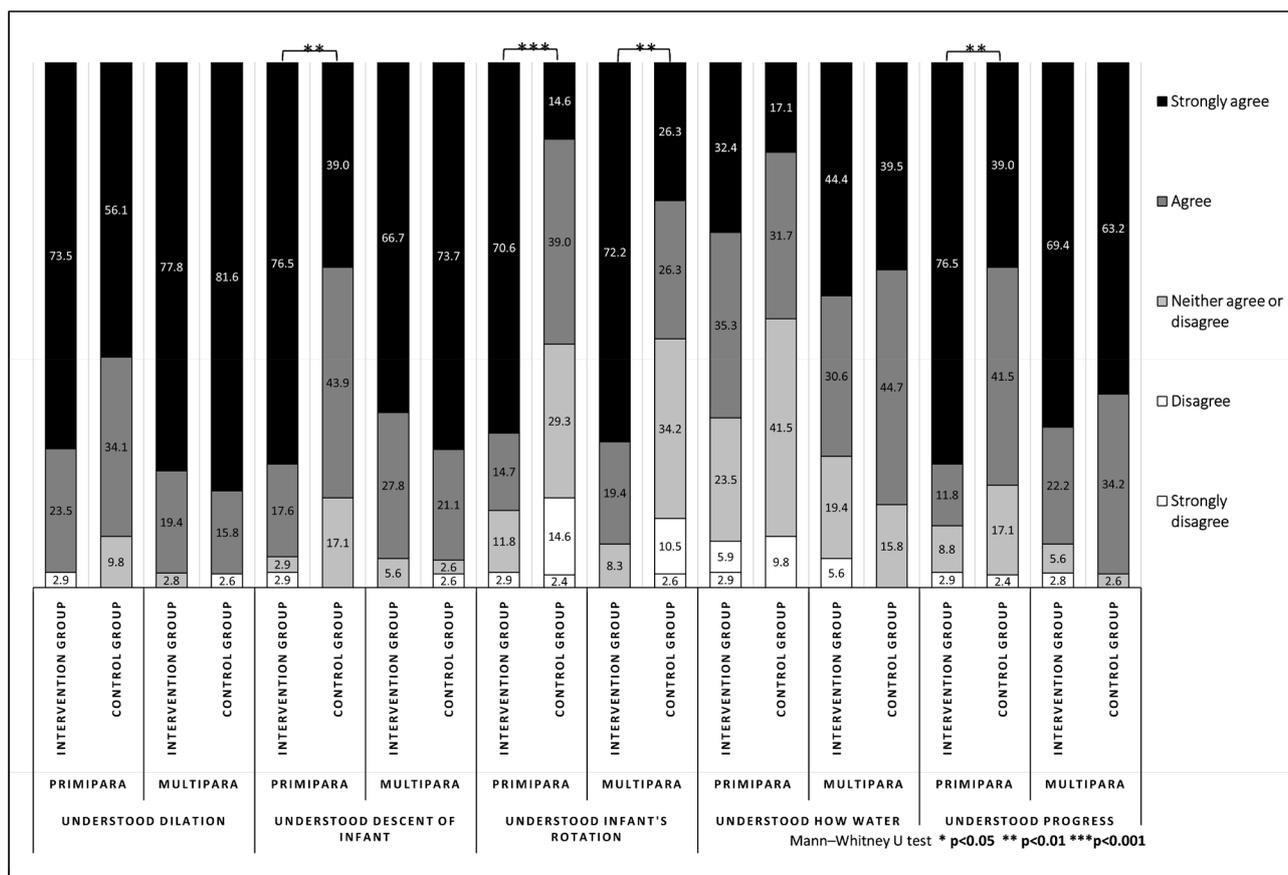


Figure 4. Understanding of process after viewing delivery animation.

75.0%, control 84.2%).

Comparison of the intervention and control groups showed revealed significantly higher scores among primipara in the intervention group in “Understood descent of infant” (p < 0.01), “Understood infant rotation (p < 0.001) and “Understood my progression through delivery” (p < 0.01). Among multipara in the control group, scores were significantly higher in “Understood infant’s rotation” (p < 0.001).

5) Satisfaction with delivery after viewing Delivery Animation

The average values classified by the subscales of the delivery experience self-evaluation are shown in Table 6. Classified by category, the average values among both primipara and multipara descend in the order of “level of trust with medical staff”, “physiological process of labor”, and “labor pain coping skills.” No significant differences were observed between the intervention and control group.

Classified by the categories of each subscale are shown in Figures 5-7.

Table 6. Level of satisfaction with delivery.

		Intervention(n = 70)		Control(n = 79)		t test	
		#	Mean ± SD	#	Mean ± SD	t value	Sign. Diff.
Labor pain coping skills	Primipara	34	3.29 ± 0.83	41	3.01 ± 0.77	1.119	n.s.
	Multipara	36	3.61 ± 0.77	38	3.63 ± 0.57	-0.975	n.s.
Level of trust with medical staff	Primipara	34	4.73 ± 0.30	41	4.57 ± 0.54	1.591	n.s.
	Multipara	36	4.63 ± 0.44	38	4.69 ± 0.38	-0.614	n.s.
Physiological process of labor	Primipara	34	3.85 ± 0.86	41	3.56 ± 0.79	1.534	n.s.
	Multipara	36	3.98 ± 0.80	38	4.25 ± 0.60	0.954	n.s.

n.s.: not significant.

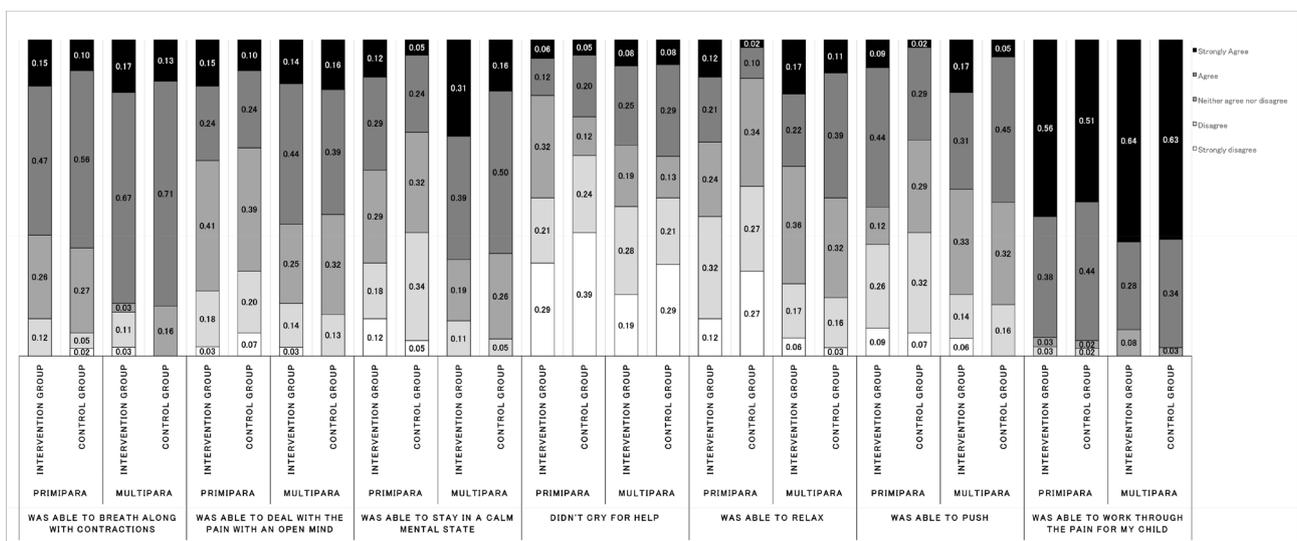


Figure 5. Level of satisfaction with childbirth (labor coping skills).

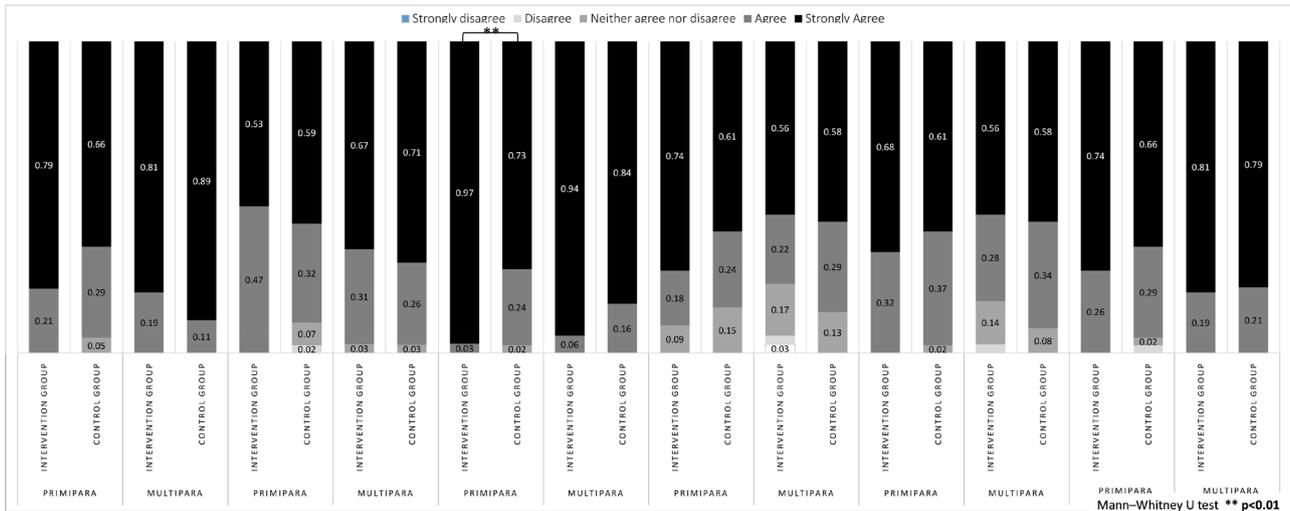


Figure 6. Level of Satisfaction with childbirth (trust in medical staff).

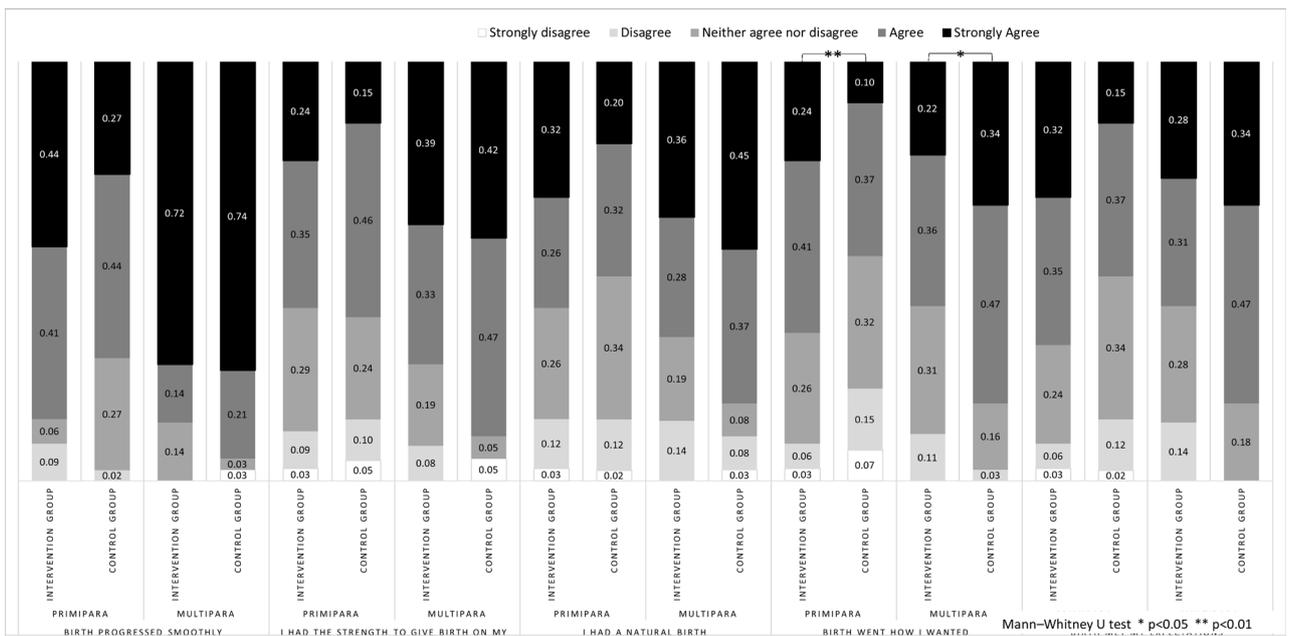


Figure 7. Level of Satisfaction with Childbirth (Physiological process of Labor).

Classified by the categories of each subscale, the highest proportion of “Strongly agree” and “Agree” responses for Labor Coping Skills (Figure 5) among primipara was in “Was able to work through the pain for my child” (intervention 94%, control 95%), followed by “Was able to breath along with contractions” (intervention 62%, control 66%).

Among multipara, the highest proportion of responses was “Was able to work through the pain for my child” (intervention 92%, control 97%), followed by “Was able to breath along with contractions” (intervention 83%, control 84%) and “Was able to stay in a calm mental state” (intervention 66%, control 69%).

For Trust in Medical Staff (Figure 6), among primipara “A midwife I could trust was nearby” (intervention 74%, control 61% was the highest, followed by

“Was able to leave everything in the midwife’s hands” (intervention 79%, control 66%) and “Staff communicated the progress of my delivery” (intervention 74%, control 66%). Among multipara, “A midwife I could trust was nearby” (intervention 94%, control 84%) was the highest, followed by “Was able to leave everything in the midwife’s hands” (81%, 89%) and “Staff communicated the progress of my delivery” (intervention 81%, control 79%).

For Physiological Process of Labor (**Figure 7**), among primipara “Birth progressed smoothly” (intervention 85%, control 71%) was the highest, followed by “Birth went how I wanted” (intervention 65%, 46%) and “I had the strength to give birth” (intervention 59%, control 61%). Among multipara, “Birth progressed smoothly” (intervention 86%, control 95%) was the highest, followed by “I had the strength to give birth” (intervention 72%, 89%) and “I gave a natural birth” (intervention 64%, control 82%).

Comparison of the intervention and control groups showed revealed significantly higher scores among primipara in the intervention group in “A midwife I could trust was nearby” ($p < 0.01$) and “Birth went how I wanted” ($p < 0.05$).

Among multipara, “Birth went how I wanted” was significantly higher ($p < 0.05$) in the control group.

a) Freeform Responses (**Table 7, Table 8**)

Freeform Responses are shown in **Table 7 & Table 8**. For primipara, responses were classified into the categories of “Labor process is easy to visualize”, “Put at ease by understanding the situation”, “It was encouraging”, “Built understanding/effective tool for understanding the situation”, “Didn’t have time to listen since I was in labor”, and points for improvement.

For multipara, responses were classified into the following seven categories: “Helped visualize the delivery process”, “Easy to understand”, “Learned about the delivery process”, “Helped me understand what I didn’t about my previous births”, “Gave me a sense of security in getting through labor”, “Calmed me down”, and points for improvement.

b) Evaluation of Delivery Animation (**Figure 8, Figure 9**)

Evaluation of Delivery Animation is shown in **Figure 8 & Figure 9**. The combined proportion of “Helpful” and “Somewhat helpful” responses concerning if the Delivery Animation was helpful in understanding the course of delivery were 89.0% for primipara and 92.0% for multipara; for responses concerning if the Delivery Animation was helpful in communicating with doctors/midwives, they were 85.0% for primipara and 86.0% for multipara.

4. Thoughts

1) Subject characteristics

In Japan, the most common age range to give birth is 30 - 34 years for both primipara and multipara [1]. However, in this study the most common ranges were 25 - 29 for primipara and 30 - 34 for multipara. This being the case, this was a relatively young group. One reason for this may be that the study took

Table 7. Opinions of delivery animation (Primipara).

Category (7)	Subcategory (16)	Context (12)
Labor process is easy to visualize	Labor process is easy to visualize	Being told how far my cervix was dilated and the animation made it easy to imagine how my delivery would go.
	Labor process is easy to visualize	It was very easy to understand. I'm glad I watched it.
Put at ease by understanding the situation	Easy to understand and reassure me through my delivery	Iknew next to nothing about going into labor, so it really helped me understand and put me at ease. It was a good experience.
	Knowing what was happening put me at ease	This was my first time giving birth, so it helped me understand what was happening and put me at ease.
	Knowing what was happening put me at ease	Was reassuring and helped me understand the steps of labor
It was encouraging	Felt encouraged	It encouraged me
	Learning the process helped me push through	Learning about the baby descending and rotating helped me understand what my baby was doing and encouraged me to keep doing my best until we get to meet.
	It helped me coach myself through it	I was nervous since this is my first birth, but seeing the latter half of delivery helped me tell myself "we're almost there".
	I helped me through	It helped my see the light at the end of the tunnel. Since this was my first birth, it put me at ease and got me through.
Built understanding	Learned a lot	I learned a lot
	Easy to understand	Visualization and animation made it easy to understand
An effective tool for understanding the situation	Animation is an effective tool for understanding the situation	I get nervous if I don't know what is happening to me, so I think animation is an effective tool to grasp the situation.
Didn't have time to listen since I was in labor	I was in labor so I couldn't focus	I was already in labor when they showed me the video, so to be honest I couldn't really pay attention. I couldn't remember after giving birth either.
	I didn't have time to listen all of it since I was in labor.	Seeing the video helped me understand, but I couldn't listen to all of it because of the labor pains.
Points forimprovement	It would be better if we could watch it during the checkup instead of on the day.	I thought it would be easier to understand if I saw the video at the checkup one or two weeks before my due date instead of on the day.
	It would be easier to see if the lines were thicker or the letters were bigger.	I didn't have my glasses or contacts when I was in labor, so it would have been easier if the letter were bigger or the lines were thicker.

Table 8. Opinions of delivery animation (Multipara).

Category (7)	Subcategory (24)	Context (23)
Able to visualizedelivery progress	I felt the baby descending when I was in labor	I could feel the movement of the babywhile I was in labor.
	I thought back to the video and pictured what was happening	I thought back to the video and pictured what was happening while I was giving birth.
	Got a general idea of the situation	Detailed explanation of the process of childbirth made it easy to visualize.
	Easy to imagine	Easier to understand than a verbal explanation.
	Could picture it	Thinking back to it helped me picture what was happening during the delivery, so it was useful.
	Could picture contractions	During labor, I was able to calm my breathing while thinking about the baby moving and coming out. It helped me picture my contractions.

Continued

	Could picture progress of my delivery	Easy to understand. Made me wonder how much I was dilated.
	Could picture it	Easy to understand and picture the delivery. I'm glad I watched it before giving birth.
	Understood dilation and the baby descending	Understood dilation and the baby descending and gave me courage knowing it was almost over.
	Made me think about how close I was to the end	I could understand the process and think about how far I had left to go.
	Allowed me to picture the delivery as it happened	Allowed me to picture the delivery as it happened
	It came to mind it while giving birth and I could picture it	Easy to understand and popped into my head during labor, so I could picture what was happening.
Easy to understand	Easy to understand	Easy to understand dilation and descent
	Easy to understand	Very easy to understand
	Easy to understand	Easy to understand my birth represented with numbers and animation.
	Easy to understand	Easy to understand.
Came to understand delivery process	Learned a lot	I understood how the baby descends.
	Learned a lot	Seeing a moving video made it easy to understand what stage of labor I was at.
Came to understand things not understood about previous birth	Learned things I didn't know	It was my third birth but there was a lot I didn't know. I learned a lot.
	Learned things I didn't know for my first birth	Learned things I didn't know for my first birth.
Gave me a sense of security in getting through labor	Gave me a sense of security in getting through labor	Easy to understand and gave me a sense of security in getting through labor.
	Eased my concerns	Each explanation had an animation, so it was easy to understand and eased my concerns.
Calmed me down	Calmed me down a little	When I was in labor, remembering the video calmed me down a little.
Points for improvement	Maybe not realistic enough	Easy to understand at a glance, but maybe a little unrealistic. Would be better to show it from the perspective of the one giving birth.

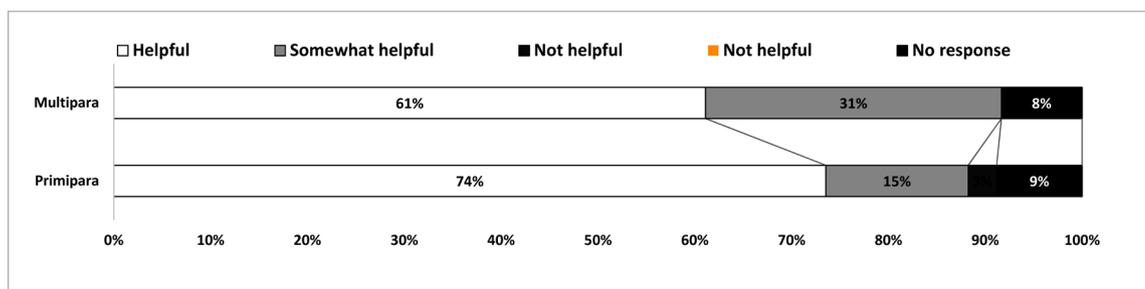


Figure 8. Was Delivery Animation Helpful in Understanding the Course of Childbirth?

place at a low-risk institution. 92% of multipara in both groups did not participate in maternity (parenting) classes. For both primipara and multipara the most common sources for information about the course of labor were the Internet and friends/acquaintances. Magazines and pregnancy checkups were also

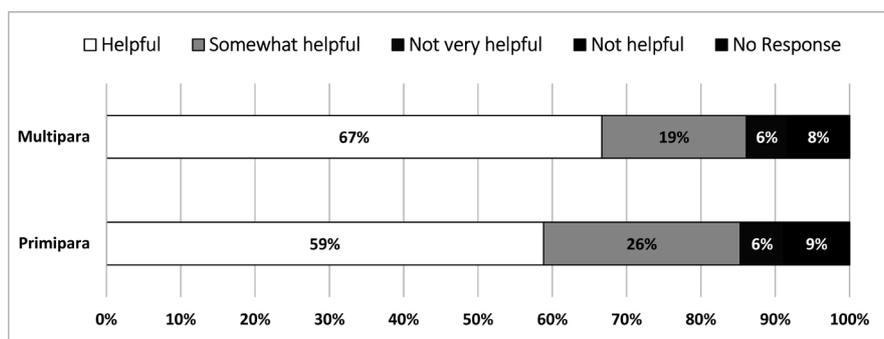


Figure 9. Was Delivery Animation Helpful in Communicating with Doctor/Midwife?

cited as sources. It is clear that even when subjects did not participate in maternity classes, they were still able to gather information through a method familiar to them.

A large portion of the subjects had a medical intervention of some sort. This may be due to it being more difficult to get women whose childbirth was already underway or progressing quickly to cooperate with the study. No significant differences were observed in method of delivery, duration of labor, blood loss during labor, birth weight, infant progress, or presence of a companion in the delivery room. Thus, the intervention/control group can be considered to be similar groups in both primipara and multipara.

2) Understanding of delivery during pregnancy

Comparison of the intervention and control groups revealed no significant differences among primipara. Among multipara, the “How the infant descends the birth canal” was significantly higher in the control group.

While differences in understanding of childbirth before the intervention were observed in one category among multipara in similar groups, none were observed in other categories; the groups can be considered mostly similar.

3) Intervention Effect of Delivery Animation

a) Understanding of delivery

Comparison of the intervention and control groups revealed significantly higher scores in among primipara in the intervention group in “Understood descent of infant”, “Understood rotation of infant”, “How the infant descends the birth canal”, and “Understood my progression through labor.” Among multipara, “Understood rotation of infant” was significantly higher in the control group.

In prior research, the clinical application of 3D computer graphics by way of digital devices has been used in dental care as an explanatory tool and for informed consent using a 3D model to demonstrate procedures [7] [11] [12]. These tools have been reported to contribute to ease of explanation and degree of understanding for the patient.

Animation and images contribute to subjects’ understanding of pregnancy and childbirth. Sumimoto [13] developed digital materials using 3D computer graphics for maternity management education and reported that realistic images

were easier to understand than schema based on written materials and that video—and 3D graphics even more so—were easier to understand than still images. Similarly to these results, we saw in our study as well that the use of animation contributed to subjects' understanding of pregnancy and childbirth.

The freeform responses in this study were classified into categories such as “Labor process is easy to visualize” and “Put at ease by understanding the situation.” for primipara and “Able to visualize delivery progress”, “Easy to understand”, “Came to understand delivery process”, and “Came to understand things not understood about previous birth” for multipara. Furthermore, the Delivery Animation was evaluated highly: the responses of “Helpful” and “Somewhat helpful” combined made up 89.0% for primipara and 92.0% for multipara.

From the above results, we can see that individual explanation of the delivery process using the Delivery Animation was effective at increase the understanding of the subjects.

b) Satisfaction with delivery

Prior research has reported that self-evaluation of the childbirth experience has an effect on mental health, development of maternal attachment, inclination toward postpartum depression, and the burden of childcare [13] [14] [15] [16] [17].

Sekizuka reports [18] that compared to groups with a higher satisfaction with birth, groups with low satisfaction have a higher inclination for postpartum depression, their immune response is suppressed, and stress response is high. Additionally, Tokiwa [19] states that mothers who believe they were unable to maintain self control during childbirth gain no sense of satisfaction from the experience, leading to a higher inclination for postpartum depression.

Such studies by many researchers have made it clear that low satisfaction with the experience of childbirth is linked to higher incidence of postpartum depression. For this reason, the Healthy Parents and Children 21 (Second Phase) program has increased the percentage of mothers satisfied with pregnancy and childbirth from a baseline of 63.7% (2013) to 82.8% (2017). The target satisfaction rate was 70.0% by the 5-year evaluation, and 85% by the final 10-year evaluation [20].

In the subordinate concept classification of the self-evaluation, this study shows high average values in medical staff trust, physiological process of labor, and labor coping skills, descending in that order. These results line up with those of Tokiwa [19] targeting subjects in day 1 - 7 following delivery and those of Yamaguchi [21] targeting subjects up to day 4. However, no significant differences were observed between the intervention and control groups. Tokiwa [19] offers the state of delivery and the health of the newborn as reasons, and these may contribute to the lack of significant difference in this study as well.

On one hand comparison between the intervention and control groups in each category of the subordinate concept classification revealed significantly

higher scores in “A midwife I could trust was nearby” ($p < 0.01$) and “Birth met my expectations” ($p < 0.05$) in the intervention group. Tsugihara [22] cites obstetrical factors, ability to cope with stress, mental factors, relationship with medical staff, and other factors related to care provider as factors which affect the degree of satisfaction with childbirth.

Tokiwa [19] states that having dependable medical staff during labor and measures to deal with the anxiety of delivery increases the degree of satisfaction with the experience. In turn, as Sadler, *et al.* [23] state, this helps to prevent postpartum depression. In this study we also found that having a midwife nearby during labor offering emotional support to help deal with the anxiety of delivery contributed to higher levels of satisfaction surrounding the birth.

For multipara, however, “Birth met my expectations” ($p < 0.05$) was significantly higher in the control group. We believe the reason for this is that the proportion of natural births with no significant differences was 25% for the intervention group and 45% for the control, and the low amount of medical intervention required for these births had an effect on the result.

From the findings mentioned above, based on the differences found in degree of understanding of the process of delivery between the intervention and control groups, the results of the self-evaluation scale for experience of delivery, and opinions on and evaluation of the Delivery Animation, it is clear that it was a useful communication tool for delivering mothers and midwives. We believe individual explanation had an effect in increasing understanding and satisfaction of parturients. This was new territory.

4) Results of verification of hypothesis

The higher scores of the intervention group in degree of understanding of the delivery process were partially validated for both primipara and multipara.

The higher scores of the intervention group in degree of satisfaction with the experience of delivery was partially validated for primipara, but not for multipara.

5) Limitations and issues

Limited number of subjects at a single institution. Points for improvement are including a larger number of subjects, consideration of intervention methods which involve the husband, and improvement of the animation.

5. Conclusion

This study compared two groups, the intervention and control, with the goal of revealing the influence an individual explanation of the course of delivery made by a midwife with the aid of the Delivery Animation has on parturients’ childbirth experience. As a result, based on the differences found in degree of understanding of the process of delivery between the intervention and control groups, the results of the abridged self-evaluation scale for experience of delivery, and opinions on and evaluation of the Delivery Animation, it is clear that individual explanation had an effect in increasing understanding and satisfaction of parturients.

Founding

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Ethical Considerations

The Ethics Committee at Osaka Medical College, with which the Author is affiliated, approved the study [Approval no.: Clinical 437 (2044)]. The Japan Family Planning Association approved the study after an ethics review (Approval No.: 28743).

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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