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Development and Evaluation of 3D Delivery Animation Software Designed to Improve the Mother's and Spouse's Satisfaction with Delivery

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Abstract

Purpose: To clarify the effectiveness of 3-D delivery animation software for the mother's and husband's satisfaction with delivery. **Subjects and Method:** We independently developed a software application used to display the pelvic region and explain the labor process. The study involved a collaboration with hospital staff who recruited 18 primiparous and 18 multiparous mothers who were hospitalized for delivery at Facility A. The midwife explained the process of delivery using the "Delivery Animation Software". A self-administered, anonymous questionnaire was distributed and analyzed separately for primiparous and multiparous mothers and their husbands. **Results:** 1) For both primiparous and multiparous couples, both mothers and their husbands gained a significantly higher level of understanding after delivery than during pregnancy. 2) The Self-Evaluation Scale for Experience of Delivery results were as follows: "I did my best for the baby even if it was painful" was selected more often for "birth coping skills"; "reliable medical staff" was selected more often for "physiological birth process"; "the birth progressed as I expected" was selected frequently by primiparous mothers; and "the birth progressed smoothly" was selected often by multiparous mothers. 3) In terms of husbands' satisfaction with the delivery, "I was satisfied with the delivery", "I was given an easy-to-understand explanation", and "They explained the process to me" was selected of primiparous and multiparous fathers. 4) All primiparous and multiparous mothers positively evaluated whether the delivery animation was helpful in understanding the process of delivery. **Conclusion:** The delivery animation was effective in improving the understanding and satisfaction of both the mothers and their husbands.

1. Introduction

Providing an expectant mother with an image of the individual delivery phenomenon is expected to facilitate her understanding of the progress of delivery and her future prospects, and has a positive effect on the mental aspect, the fourth of the first four elements of delivery (birth canal, product, output, and mental aspect). However, it is difficult for the mother and the husband to visualize the delivery phenomenon occurring in the pelvis.

Currently, pre-delivery education in Japan, such as classes and parenting couples' classes, explains the process of delivery using photographs, dolls, and anatomical models. Meanwhile, support for spatial cognition in actual situations is necessary for understanding each delivery and its unique circumstances.

In a study that clarified the relationship among an expectant mother's image of childbirth during pregnancy, confidence in childbirth, and satisfaction with the childbirth experience [1], women with a more positive image of childbirth had a higher sense of confidence in childbirth, and such women were more satisfied with childbirth within five days of delivery. Consequently, the study reported that midwives should be aware of how mothers, the recipients of care, feel and what kind of care they need.

Meanwhile, the role of the father in pregnancy, delivery, and childcare is becoming increasingly important. Sharing the delivery experience with the husband is the starting point for the couple to cope with childbirth and to cooperate in raising the child while fulfilling their respective roles. This is a particularly important experience for fathers, who are less aware of their role compared to mothers who carry the child during pregnancy. In addition, the proactive delivery of the baby increases the mother's satisfaction with the delivery. One of the factors that influence satisfaction is the availability of sufficient support from the husband during delivery. Research has shown that the visiting husband's awareness of paternity increases, and he becomes more active in housework and childcare, facilitating the transition to the role of father [2].

However, no established method exists on effective nursing care to alleviate the anxiety and confusion of a husband who is present during delivery [3]. Furthermore, fathers' child-rearing environments are changing significantly, and it is important to provide support during delivery, which is the start of the transition to the role of father, to prevent postpartum depression in fathers as well as mothers.

Previous related studies include "3D CG Perinatal Diagnosis and Delivery Care Education System" [4] and "Understanding with CG Movies! The Mechanisms of Labor and Delivery and Assistance Methods" [5]. Both are educational

materials, as it is difficult for expectant mothers and their families to visualize the dynamic process of childbirth. This study developed a digital communication support tool similar to those that have been developed in various fields and are currently used in clinical practice for patient briefings and other purposes [6]. However, no tool has been developed to visualize the dynamic and individualized pelvic delivery phenomenon during the childbearing period for the woman and her family.

Therefore, we developed and evaluated a three-dimensional delivery animation software ("delivery animation") [7]. The findings revealed a significant difference between the intervention and control groups in terms of understanding the progress of delivery, and the results of satisfaction with the "Self-Evaluation Scale for Experience of Delivery" revealed that the delivery animation was a communication tool between the mother and the midwife. The opinions about the delivery animation included "I could understand the status of delivery", "It was easy to visualize the status of delivery", and "I felt encouraged".

However, some requests were made regarding the difficulty in understanding the position of the mother and the fetus throughout the process. Nevertheless, this contributed to the improvement of the mother's understanding and satisfaction with her delivery experience. This means that, although the software was able to provide a cross-sectional explanation at the time, challenges remained regarding presenting information on a time axis within the overall progression. In addition, the explanations were provided only to the expectant mother. Meanwhile, methods for promoting the understanding of the process for husbands who are present during births are mainly limited to verbal explanations, and it has been highlighted that they find the situation difficult to understand and are likely to feel confused and anxious [8]. Based on the above, we developed and evaluated software that 1) visualizes the positioning of the mother and the fetus throughout the delivery process in a novel way and 2) improves the capabilities of the delivery animation for the husband in addition to the mother.

The use of the new delivery animation software is expected to aid the mother's understanding of the progress of delivery and plan for the future, and to have a positive effect on the fourth element, the mental aspect. Moreover, we believe that husbands, who have many opportunities to be present with the mothers, can share the current progress and predicted future information with the medical staff, which will help in achieving safe deliveries. Furthermore, we expect the animation to increase delivery satisfaction and have a positive influence on the child-rearing period.

This article is an English-language rewrite of a paper previously published in Japanese [9], in which the number of subjects was increased from 13 to 36 mother and husband couples.

Study Purpose

To clarify the effects of midwives' explanations of the delivery process using a

delivery animation software on mothers' and husbands' level of understanding of the delivery process and satisfaction with the delivery experience.

2. Research Methodology

2.1. Definitions of Terminology

Delivery Animation is shown in Figure 1.

1) Definition

We independently developed a software application used to display the pelvic region and explain the labor process. Pelvic exam data (cervical dilation and fetal station) are input using the Bishop score, which is a scale currently used in 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).

2) Development process

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

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

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

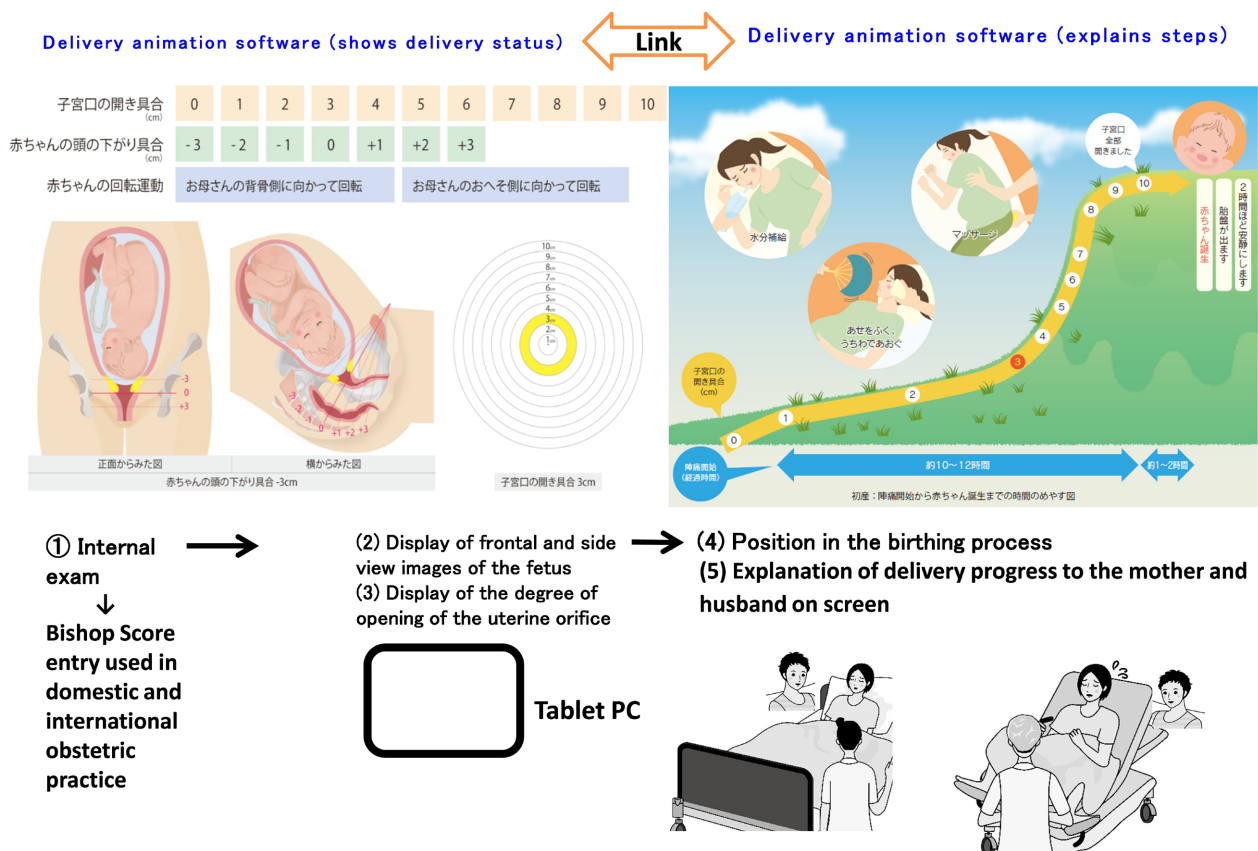Figure 1. Delivery animation software.

3) Software content

The details of the Delivery Animation Software are as follows:

a) Input results of pelvic exam (dilation and fetal station).

b) 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).

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

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

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

2.2. Method of Research

1) Research design: Two-group cross comparative study

2) Survey period: December 2019 to March 2020 (suspended because of the spread of COVID-19) and July 2023 to March 2024

3) Research subjects:

A total of 36 pairs of mothers and husbands (18 primiparous couples and 18 multiparous couples) scheduled to deliver at Obstetrics and Gynecology Clinic A.

Inclusion Standards:

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

Exclusion Standards:

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

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

i) Under 20 years old.

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.).

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 final selected sample size was 15 subjects per group.

4) Data collection method ([Table 1](#))

a) At referral to maternity ward near end of pregnancy: Collaborative researchers (midwives) explained the study and distributed the instruction and consent forms.

b) At time of labor in hospital: A collaborative researcher (midwife) requested and confirmed the consent form.

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

d) After a pelvic examination: The collaborative researcher (midwife) recorded the findings on a partogram recorded in the usual procedure.

e) Day 1 following delivery: The collaborative researcher (midwife) gave the subject an anonymous questionnaire. Responses were 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.

f) At time of discharge on day 4 or 5 after delivery: The collaborative researcher (midwife) performed a birth review as per the usual procedure.

g) The head of research collected the responses.

5) Data collected:

Parturient Female

a) Subject characteristics: Age, number of births, and progression of current pregnancy.

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

c) Understanding of process of childbirth: These were created individually to gain an understanding of the baseline data. We used a four-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, and how water breaks.

Table 1. Research protocol.

	Data collection of the pregnant woman/husband					
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		
Method	Request for study participation	Confirmation/ Request of consent form	After gynecological exam, explanation of process with Delivery Animation	Midwives distributed questionnaires to healthy postpartum mothers who delivered vaginally	Questionnaire collected	Birth review
Subjects	Pregnant woman	Pregnant woman/husband	Pregnant woman/husband	Pregnant woman/ husband		Pregnant woman

d) 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, and presence of partner/relative in delivery room were recorded.

e) Understanding of process of childbirth: Created individually based on information presented in Delivery Animation. A five-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).

f) Satisfaction with birth: We used the abridged self-evaluation scale [10] and measured how satisfied the 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 five-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 represented 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 was verified [11] [12].

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

Husbands

a) Subject characteristics: age and number of previous births attended.

b) Sources of information on the delivery process.

c) Understanding of the delivery process during pregnancy: Same as that of the mother.

d) Situation of delivery in the presence of the mother: Time and status of visitation.

e) Degree of understanding of the process of delivery after delivery: Same as that of the mother.

f) Evaluation of the delivery experience: A five-point Likert-type scale ranging from 5 "strongly agree" to 1 "completely disagree" for six items (support, support efforts, satisfaction, explanation of procedures and tests, and explanation of the process), referring to previous studies [13] [14].

g) Evaluation of the delivery animation: Same as that of the mother.

6) Method of analysis/evaluation (parturient):

Statistical analysis used SPSS statistics 29 for Windows.

a) Descriptive statistics: Subject characteristics by primiparous and multiparous status, understanding of the delivery process during pregnancy, delivery status, understanding of the delivery process after delivery, self-evaluation scale of delivery experience (abridged version) (maternity), delivery satisfaction (husband), and evaluation of delivery animation were recorded.

b) Inferential statistics: The level of understanding of the delivery process during pregnancy and after delivery was compared for primiparous and multiparous mothers. A Wilcoxon rank-sum test was used to confirm the distribution of quantitative data, and the level of statistical significance was set at less than 5%.

7) Ethical considerations

The subjects were informed by the midwife who collaborated in the study, using an explanation sheet and consent form, and their consent was obtained. Ethical approval was obtained from the Research Ethics Committee of University A, to which the first author belongs (Gan 131 (2790)) and from the Japan Family Planning Association (JFPA-2019002).

3. Results

The number of subjects is shown in Table 2.

The valid response rate was 100% for both the mothers and husbands.

3.1. Subject Characteristics and Pregnancy Progression

The characteristics of the subjects and the course of pregnancy are described in Table 3.

Regarding age, 14 (77.8%) primiparous mothers and 12 (66.7%) husbands were between 25 and 29 years of age.

For multiparous couples, majority of the mothers (10, 55.6%) were 25 - 29 years old, while majority of the husbands (8, 44.4%) were 30 - 34 years old. A total of 14 (77.8%) primiparous and 12 (66.7%) multiparous women selected that their pregnancy "went well". Subjects who selected that their pregnancy "did not go well" included four primipara (22.2%) and six multipara (33.3%). Of these primiparous patients, three had "anemia" and one had "imminent preterm delivery" while among the multiparous patients, five had "anemia" and one had "imminent miscarriage". The most common source of information regarding the course of delivery was "Internet" for primiparous mothers and husbands, and multiparous mothers and their husbands. For multiparous husbands, nine (50.0%) had been in the delivery room once before and three (16.7%) twice before.

3.2. Delivery Status

Table 4 and Table 5 list the subjects' delivery status.

Table 2. Number of subjects.

	Parturient Female (n = 36)		Husband (n = 36)	
	Subjects	%	Subjects	%
Primipara	18	50.0	18	50.0
Multipara	18	50.0	18	50.0
Total	36	100.0	36	100.0

Table 3. Subject characteristics.

		Parturient Female (n = 36)				Husband (n = 36)			
		Primipara (n = 18)		Multipara (n = 18)		Primipara (n = 18)		Multipara (n = 18)	
		#	%	#	%	#	%	#	%
	20 - 24	2	11.1	1	5.6	2	11.1	0	0.0
	25 - 29	14	77.8	10	55.6	12	66.7	3	16.7
Age	30 - 34	2	11.1	7	38.9	2	11.1	8	44.4
	35 - 39	0	0.0	4	57.1	2	11.1	4	22.2
	40 - 44	0	0.0	0	0.0	0	0.0	3	16.7
Progression of current pregnancy	Normal	14	77.8	12	66.7	-		-	
	Abnormal	4	22.2	6	33.3	-		-	
	Maternity classes	3	16.7	1	5.6	1	11.1	3	16.7
	Pregnancy checkup	7	38.9	8	44.4	4	22.2	3	16.7
Sources of information regarding the process of childbirth (multiple responses)	Childcare books/magazines	5	27.8	4	22.2	3	16.7	1	5.6
	Internet	13	72.2	15	83.3	8	44.4	8	44.4
	Mother	10	55.2	2	11.1	3	33.3	1	5.6
	Mother-in-law	0	0.0	0	0.0	1	5.6	1	5.6
	Sister	3	16.7	1	5.6	3	16.7	1	5.6
	Friend/Acquaintance	10	55.6	2	11.1	2	11.1	1	5.6
	Other	0	0.0	0	0.0	0	0.0	1	5.6

Table 4. State of subject delivery.

		Parturient Female (n = 38)			
		Primipara (n = 18)		Primipara (n = 18)	
		#	%	#	%
	Natural birth	3	16.7	9	50.1
	Non-natural birth				
	Induced labor (metreurynters)	7	38.9	7	38.9
Method of delivery	Induced labor (pill or IV)	9	50.0	7	38.9
	Induced contractions mid-labor (pill or IV)	7	38.9	2	11.1
	Vacuum extraction	7	38.9	0	0.0
	Abnormal rotation of infant	0	0.0	0	0.0
	Under 15 hours	18	100.0	16	88.9
Length of labor	15 - 30 hours	0	0.0	2	11.1
	Over 30 hours	0	0.0	0	0.0
	Small amount	12	66.7	13	72.2
Bleeding during labor	Medium amount	3	16.7	5	27.8
	Large amount	3	16.7	0	0.0
Birth weight	Under 2500 g	0	0.0	1	5.6
	2500 - 4000 g	18	100.0	17	94.4
Progress of infant	Under hospital supervision	18	100.0	17	94.4
	Admitted to another hospital for observation	0	0.0	1	5.6

Table 5. Status of delivery with husband present.

| | | Husband (n = 36) | | | |
| | | Primipara (n = 18) | | Primipara (n = 18) | |
		#	%	#	%
Visitation time (Multiple answers)	Time from admission to the hospital until entrance to the delivery room	15	83.3	17	94.4
	Time from entrance to the delivery room until birth	10	55.6	10	55.6
	1 - 2 hours after delivery	9	50.0	9	50.0
Time of visitation (Multiple answers)	Massaging the lower back and other parts of the body	13	72.2	10	55.6
	Hydration	15	83.3	12	66.7
	Sweat wiping	10	55.6	5	27.8
	Did breathing exercises together	9	50.0	1	5.6
	Hand holding	15	83.3	9	50.0
	Offered encouragement	11	61.1	13	72.2
	Was at the bedside during childbirth	14	77.8	15	83.3
	Was at the feet of the birth mother (wife) during delivery	1	5.6	1	5.6
	Held the baby in the delivery room	11	61.1	13	72.2
	Touched the baby in the delivery room	13	72.2	14	77.8

Regarding the method of delivery, "natural birth" was selected by 3 (16.7%) primiparous and 9 (50.1%) multiparous mothers, while "delivery other than natural birth" was selected by 15 (83.3%) primiparous and 9 (50.0%) multiparous mothers. The most common type of "other than natural delivery" was "induced delivery (oral or intravenous)", selected by nine (50.0%) primiparous women and seven (38.9%) multiparous women. The delivery time was "less than 15 hours" for all primiparous and 16 (88.9%) multiparous mothers. The amount of blood loss at delivery was "small" or "medium" in 15 (83.3%) primiparous and all multiparous mothers. Birth weight was between 2500 and 4000 g in all primiparous and 17 (94.4%) multiparous mothers. All primiparous and 17 (94.4%) multiparous mothers were "under observation in the hospital".

The primiparous husbands were more likely to "massage the lower back", "hydrate", "hold hands", "be at the bedside during delivery" and "touch the baby in the delivery room" while the multiparous husbands were more likely to "hydrate", "offer encouragement", "be at the bedside during delivery", "hold the baby in the delivery room" and "touch the baby in the delivery room" during visitation.

3.3. Understanding of the Process of Childbirth during Pregnancy and after Delivery

Figures 2-5 illustrate the level of understanding of the delivery process during pregnancy and after delivery.
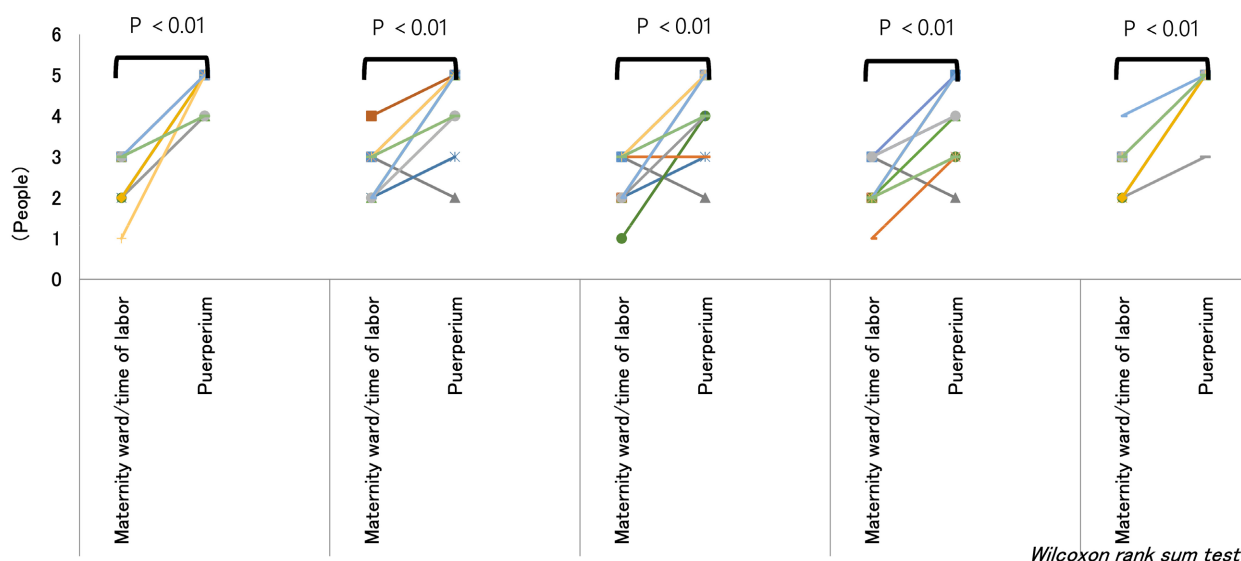
Figure 2. Level of knowledge of purocess of childbirth (primipara n = 18).
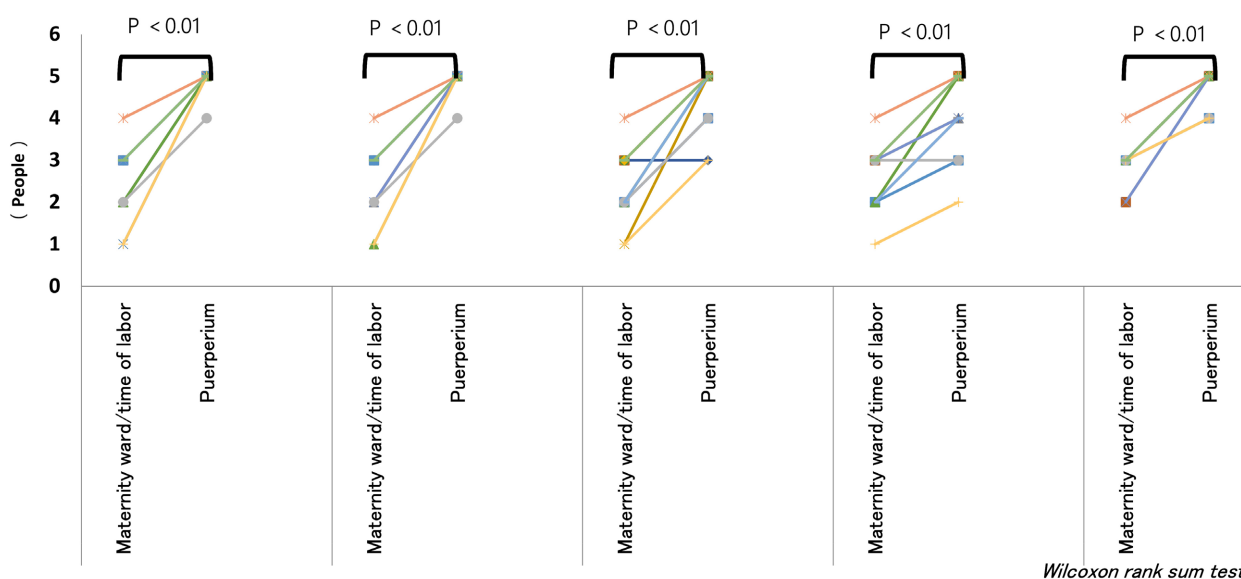

Figure 3. Level of knowledge of purocess of childbirth (multipara n = 18).

1) Expectant mothers: The level of understanding was significantly higher after delivery than during pregnancy for all items for both primiparous and multiparous mothers. All primiparous and multiparous mothers answered, "strongly agree" or "somewhat agree" for "understanding the extent of opening of the uterus" and "understanding the progress of delivery".

2) Husbands: The level of understanding was significantly higher after delivery than during pregnancy in all items for both primiparous and multiparous couples.

3.4. Satisfaction with Delivery

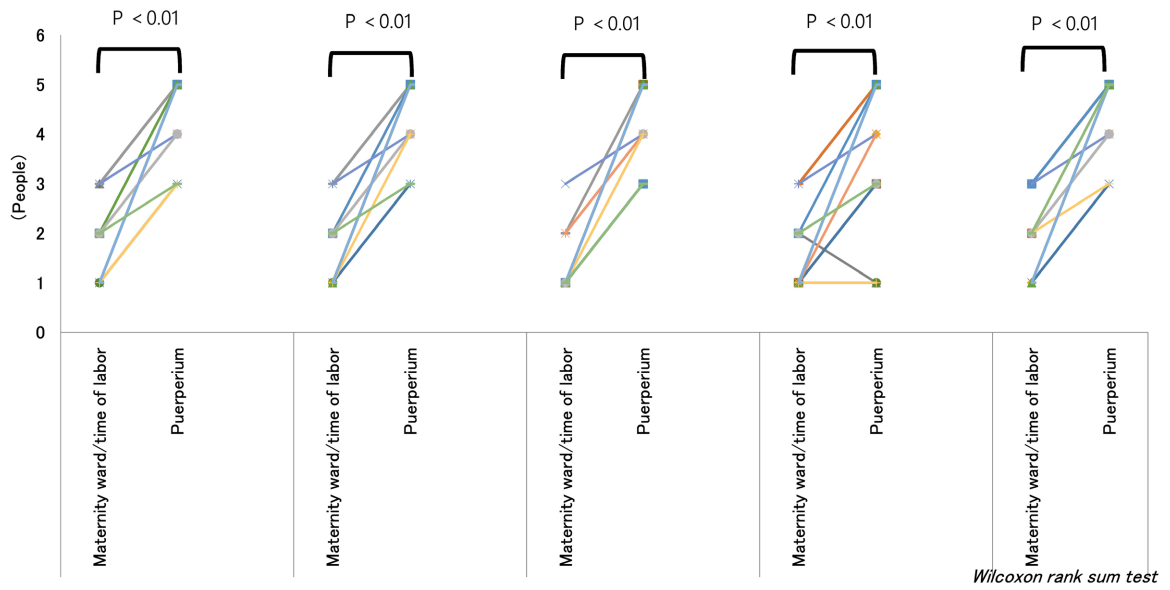The level of satisfaction with delivery is presented in Table 6 and Figures 6-8.

Figure 4. Level of knowledge of purocess of childbirth (primipara husband n = 18).
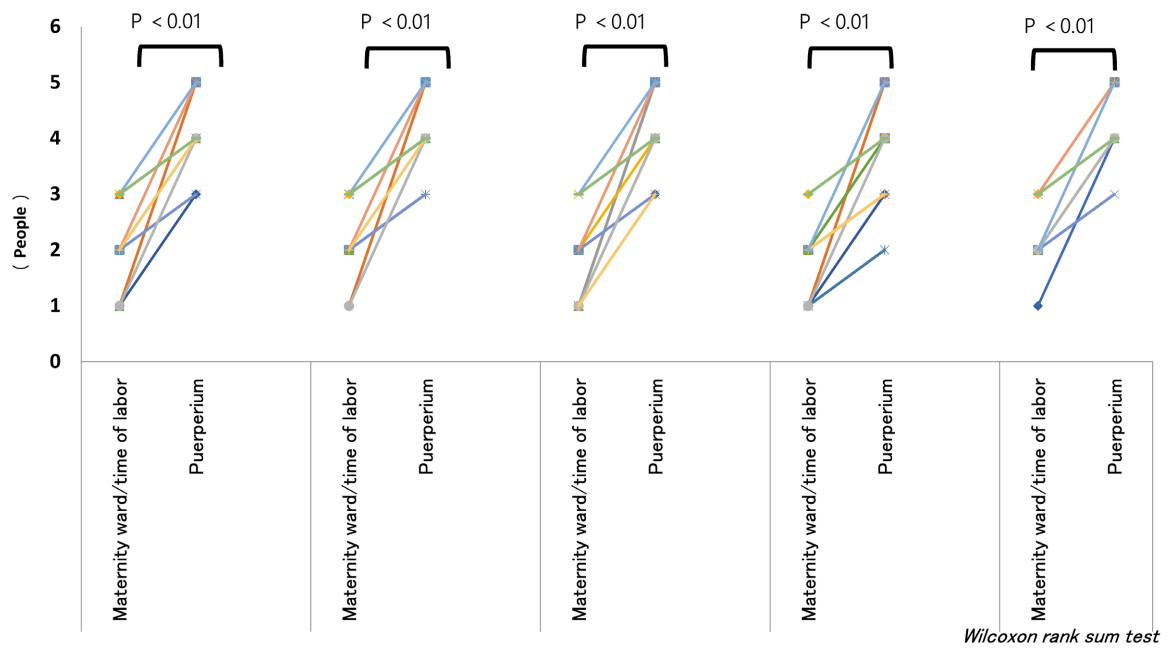

Figure 5. Level of knowledge of purocess of childbirth (multipara husband n = 18).

Table 6. Level of satisfaction with delivery (Parturient Female).

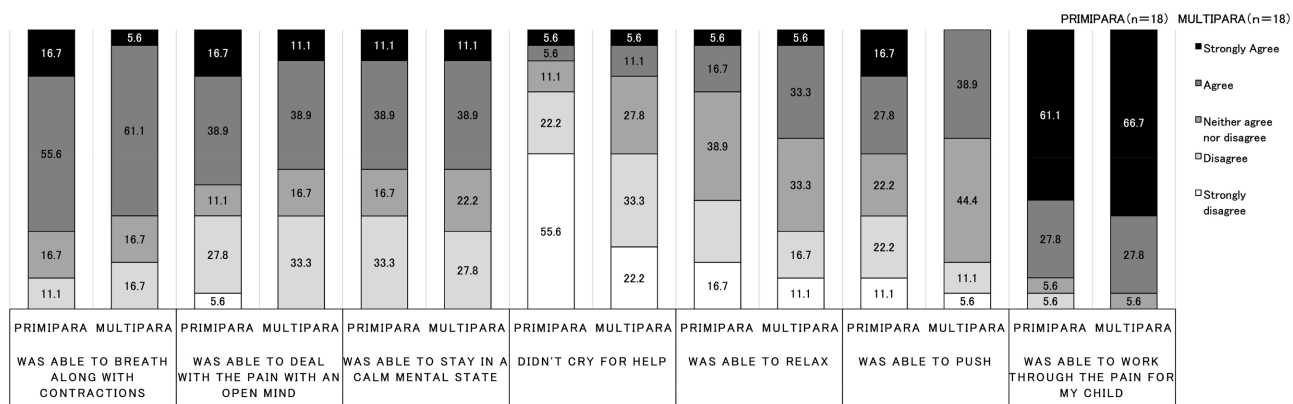| Subscale		#	Mean ± SD
Labor pain coping skills	Primipara	18	3.73 ± 0.55
	Multipara	18	3.88 ± 0.37
Level of trust with medical staff	Primipara	18	4.84 ± 0.30
	Multipara	18	4.74 ± 0.39
Physiological process of labor	Primipara	18	3.86 ± 0.88
	Multipara	18	4.24 ± 0.77

Figure 6. Level of satisfaction with childbirth (labor coping skills).
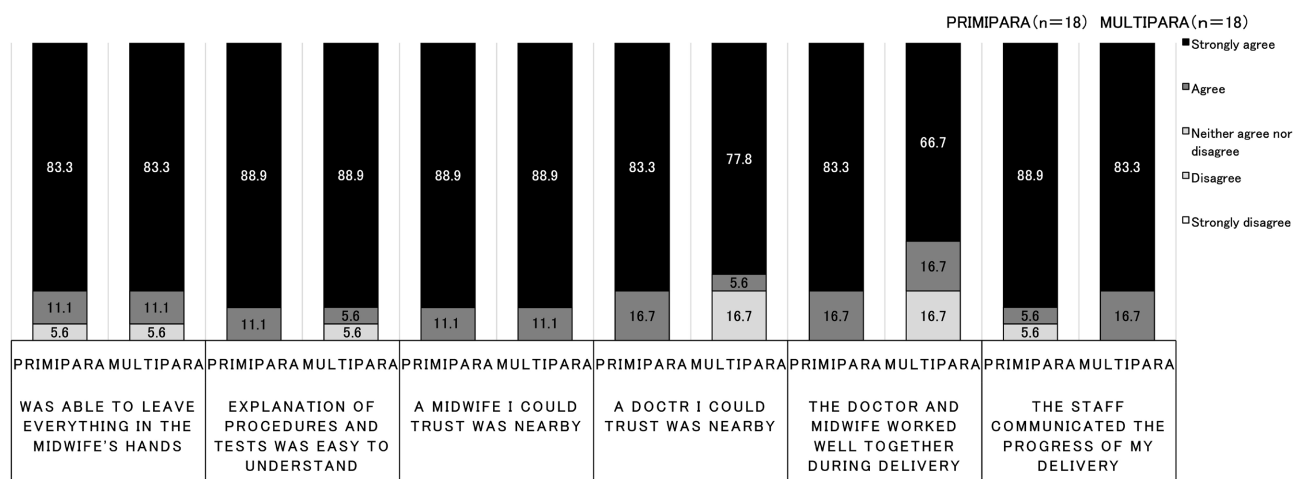

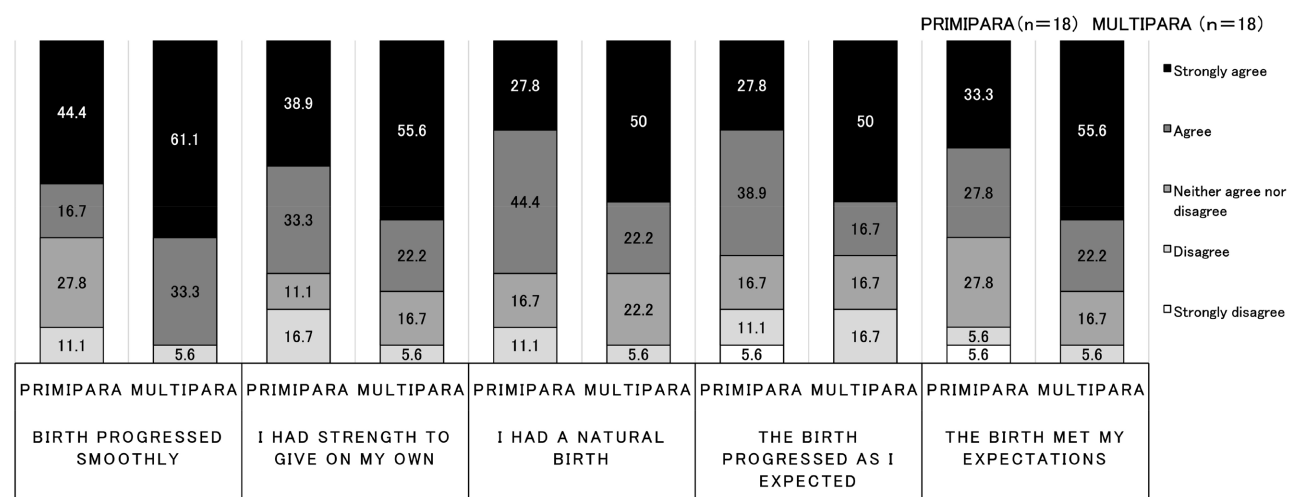**Figure 7.** Level of satisfaction with childbirth (trust in medical staff).

Figure 8. Level of satisfaction with childbirth (physiological process of labor).

1) Expectant mothers: The mean values for each subscale of self-evaluation of the delivery experience are provided in Table 6. The mean values for both primiparous and multiparous mothers were higher in the order of trust in medical

staff, physiological course of delivery, and coping with labor pains. Subsequently, the percentages of "strongly agree" and "agree" were the highest in "birth coping skills" (Figure 6), with 88.9% of the primiparous and 94.5% of the multiparous mothers agreeing that they "did their best for the baby even if it was painful". For "reliable medical staff" (Figure 7), the selection rate was generally high for both primiparous and multiparous mothers. For "physiological birth process" (Figure 8), 72.2% of the primiparous mothers answered, "I was able to give birth on my own" and "the birth proceeded naturally", while 94.4% of the multiparous respondents answered, "the birth progressed smoothly".

2) Husbands: For satisfaction with childbirth (Figure 9), the percentages of "very much agree" and "agree" were high for "I was satisfied with the birth" (all primiparous and 88.9% of multiparous couples), "I was given clear explanations" (88.9% of both primiparous and multiparous couples), and "I was informed about the progress of the birth" (94.5% of primiparous couples and 88.9% of multiparous couples).

3.5. Evaluation of Delivery Animation (Figure 10)

Figure 10 describes the results of subjects' evaluations of the delivery animation.

All primiparous and multiparous mothers and their husbands selected "helpful" or "somewhat helpful" regarding the question "Did the animation help you understand the process of delivery?"
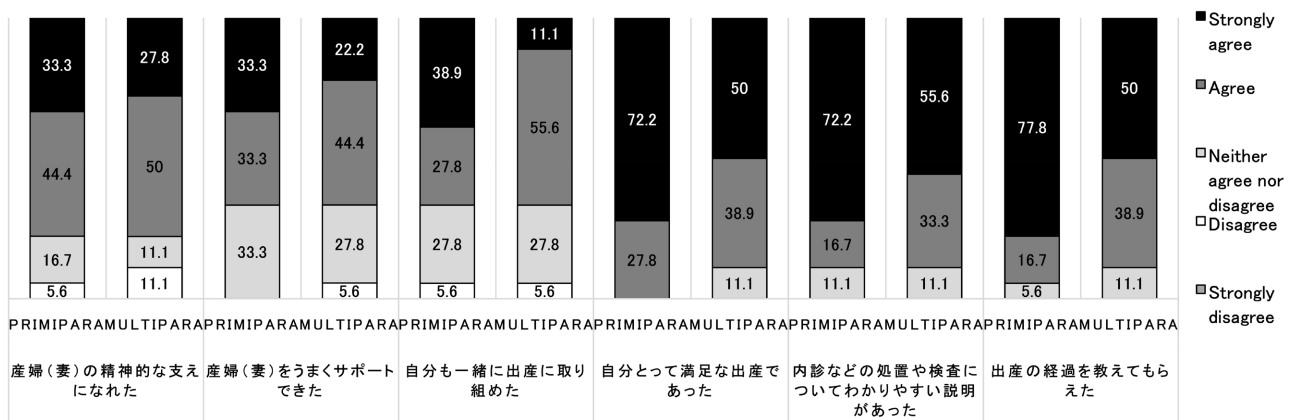

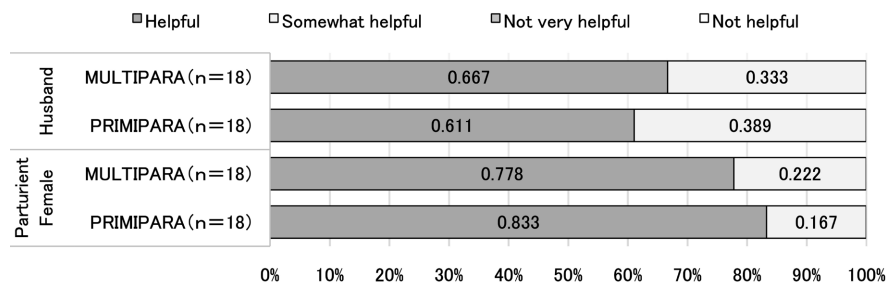**Figure 9.** Level of satisfaction with childbirth (husband).

Figure 10. Was THE Delivery Animation Helpful in understanding the course of childbirth?

4. Discussion

4.1. Subject Characteristics

In Japan, the most common age of childbearing for both primiparous and multiparous women is 30 - 34 years [15] (MHLW, 2022), but in this study, primiparous women were most frequent between 25 and 29 years of age. Thus, the primiparous women were a slightly younger group. This may be due to the low-risk facilities. The Internet was the most common source of information on the delivery process for both primiparous and multiparous mothers and their husbands, thus indicating that they were able to gather information in a way that was familiar to them.

In terms of the delivery status, the subjects frequently received some form of medical intervention. This may have been because it was difficult to obtain cooperation from subjects whose delivery was in progress or was progressing rapidly.

4.2. Results of Delivery Animation Intervention

1) Level of understanding of childbirth

From comparing the period during pregnancy and after delivery, it was revealed that the level of understanding after delivery was significantly higher for both primiparous and multiparous mothers. All of the primiparous women and their husbands answered that the delivery animation was "helpful" or "somewhat helpful" in understanding the process of delivery.

In our previous study comparing intervention and control groups [7], the intervention group was significantly more likely to understand the primiparous "rotation" and "delivery process" in terms of comprehension of the delivery process and was significantly more likely to understand the multiparous "rotation". In the present study, the addition of a new visualization of the overall positioning throughout the delivery process was considered to have at least contributed to the higher level of understanding.

In previous studies, 3D computer graphics using digital equipment have been used in clinical applications, such as dental treatment and surgical explanation using 3D human body models, as a tool for patient briefings and obtaining informed consent. Their effectiveness has been reported to contribute to the ease of briefing and the level of understanding of the recipient of the explanation [16] [17] [18].

In pregnancy and delivery, Sumimoto *et al.* [19] developed digital educational materials for obstetric management education using 3D computer graphics and reported that the use of realistic images rather than book-based schemas, moving images such as videos rather than still images, and 2D computer graphics aided in comprehension. In this study, the use of animation and video was believed to have contributed to subjects' level of comprehension.

2) Satisfaction with delivery

The mean values in subjects' self-evaluation of the delivery experience by

subcategory were higher for both primiparous and multiparous mothers in this order: trust in the medical staff, physiological delivery process, and coping with labor pains. These results were similar to those of Tokiwa [20] in postpartum mothers on days 1 - 7 and Yamaguchi [21] in postpartum mothers up to day 4.

Next, regarding the items of each subscale, "childbirth coping skills" showed a high percentage of "I did my best for the baby even if it was painful", while "reliable medical staff" indicated an overall high level of satisfaction, and for "physiological birth process", a high percentage selected "the birth went as I expected" in the primiparous group and "the birth went smoothly" in the multiparous group.

In our previous study comparing intervention and control groups [7], the intervention group had a significantly higher percentage of primiparous women who "had a trusted midwife by their side". Tsugihara [22] identified obstetric factors, stress coping skills, psychological factors, and factors related to care providers such as the involvement of medical staff as influencing satisfaction with childbirth. Tokiwa [20] stated that the presence of reliable medical staff during the delivery period and coping with anxiety at the time of delivery increased satisfaction with the childbirth experience, which in turn contributed to the prevention of postpartum depression. In this study, coping with anxiety during childbirth, such as staying with the mother during childbirth and providing emotional support, were thought to have contributed to the satisfaction level of the childbirth experience.

In terms of husbands' satisfaction, "I was satisfied with the birth", "I received easy-to-understand explanations" and "I was informed about the progress" were the most frequent responses for both primiparous and multiparous couples. All of the primiparous and multiparous couples gave positive ratings regarding whether the delivery animation was helpful in understanding the process of childbirth. Regarding the husband's presence at the birth, although the husband wanted to help alleviate the pain of labor, they also felt helpless because they did not know whether the animation was helpful, felt dissonance between their own concerns and the calm manner and encouragement of the medical staff, and had negative feelings toward being present at the birth and toward the medical staff [8]. We believe that the high satisfaction rate was because these feelings were eased as well as the anxiety of not only the mothers but also their husbands who attended the births.

Meanwhile, the rate of mental health problems among mothers and fathers with infants increased, especially during the COVID-19 pandemic [23]. Restrictions on husbands' attendance during childbirth during the pandemic were a factor contributing to decreased satisfaction with the childbirth experience and increased frequency of mental health problems among mothers and fathers.

During the pandemic, the prohibition of the husband's presence during childbirth in approximately 63.2% of delivery facilities [24] decreased satisfaction with the childbirth experience [25], increased depression during pregnancy [26],

and increased the incidence of postpartum depression from 10% before the pandemic to 24% [27].

The effects of the husband's presence during childbirth include the significance of the couple cooperating with each other from the gestational period to get through childbirth, which is a basic starting point for raising children together, and the fact that the husband is a reliable presence during childbirth and that his support influences the wife's satisfaction with the birth. Furthermore, the risk for postpartum depression and parenting stress in mothers, which have become social problems, has been shown to be reduced [20].

Husbands are key in supporting mothers, and the importance of supporting fathers from pregnancy through child rearing is increasing. In addition, a pre-pandemic report also revealed that the percentage of Japanese fathers who were judged to be at risk for mental illness during the first year postpartum was 11.0%, almost the same level as that of mothers (10.8%) [28]. Therefore, it is important to reduce the husband's anxiety as much as possible and to support him in having a satisfying birth experience. We believe that the delivery animation can help in this regard.

In light of the above, regarding the level of understanding of the delivery process, the fact that significant differences were found for both the mothers and husbands during pregnancy and after delivery, and based on the results of satisfaction with the "Self-Evaluation Scale for Experience of Delivery" by the mothers, the results of the husband's satisfaction ratings, and the mothers' and husbands' evaluations of the delivery animation, individualized explanation of the delivery process using delivery animation was suggested to be effective in increasing mothers' understanding and satisfaction with the delivery process.

4.3. Study Limitations and Future Tasks

Limitations of this study include the limited number of subjects at a single institution, limited data collected because of the COVID-19 pandemic, the small number of subjects, and lack of a control group. Future studies should increase the number of subjects and establish a control group.

5. Conclusions

1) Both primiparous and multiparous mothers and husbands had a significantly higher level of understanding after delivery than during pregnancy.

2) In the Self-Evaluation Scale for Experience of Delivery, "I did my best for the baby even if it was painful" was selected often for "birth coping skills"; for "reliable medical staff", overall satisfaction was selected often; for "physiological birth process", "the birth progressed as I expected" was selected often by primiparous mothers; and "the birth progressed smoothly" was selected often by multiparous mothers.

3) In terms of husbands' satisfaction with the delivery, "I was satisfied with the delivery", "I was given easy-to-understand explanations", and "I was informed of

the progress" was selected as primiparous and multiparous.

4) All the primiparous and multiparous mothers gave a positive evaluation of the usefulness of the delivery animation for their understanding of the process of delivery.

These results suggest that the delivery animation has an effect on both the mothers' and husbands' understanding and satisfaction.

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Conflicts of Interest

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

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