1. INTRODUCTION

In patients who have suffered a stroke and are undergoing rehabilitation, reduced motivation for recovery and to achieve independence is a major factor that prevents effective treatment [1] and affects the level of independence in activities of daily living [2] and prognosis [3]. Therefore, the decreased motivation is a crucial challenge that deserves attention in the clinical setting. The loss of motivation may be due to impaired brain function caused by damage to the brain (direct causes) or severe stress (secondary causes), such as those resulting from the inability to move one’s body as desired. Moreover, post-stroke depression [4] and apathy (weakening of motivation that is not caused by disturbance of consciousness, cognition, or emotion) [5] are cited as causes for post-stroke loss of motivation. These symptoms are observed in approximately half of the patients who undergo rehabilitation [6]. Motivation is a subjective view that is held by the patient that is difficult to quantify, even in healthy people [2]. However, when externally assessing the patient, because motivation manifests itself in behavior that is associated with agency (voluntary action), such as “I’m actively self-training” [7], it is sometimes possible to use agency-associated behavior (voluntary action) to determine the effectiveness of interventions that are intended to engender motivation [8-10].

The expectations of nursing support in patients undergoing rehabilitation have reportedly shown that “increasing [patient] agency” is an area of medical need [11]. This study conducted interviews among patients with cerebrovascular disease to evaluate whether satisfying the patient’s need for “increasing agency” is associated with a voluntary and satisfying recovery process—that is, a motivated approach to rehabilitation. The nurse’s specific involvement in enhancing the sense of agency (SoA) includes seven items, such as “explaining whether or not an action can be performed alone to motivate the patient to continue with the rehabilitation.”

Several recent studies in the field of neurological rehabilitation have examined the relationship between the SoA and sense of ownership (SoO) [12], which are bodily perceptions that generate subjectivity with regard to body self-awareness and the effects of rehabilitation. The SoA is the sense that it is exactly you who is causing the bodily movements you are observing, and the SoO is the subjective sense that the body you are observing is exactly you. Normally, when an individual reaches out and grasps an object, he or she feels an SoA and an SoO...
with the ability to move his or her hand as intended (although he or she is consciously unaware of this because it is too obvious). However, both SoA and SoO are routinely compromised in patients with motor and sensory paralysis. Attempts to use body illusion as an intervention to change the patient’s awareness of “not being able to move as I want” have been undertaken by manipulating the senses related to body self-awareness and have been studied to eliminate factors that inhibit the movement of the affected limb [13]. In addition, experiments conducted on healthy participants have examined the relationship between the virtual lowering of body self-awareness and actual muscle activity [14] as well as between perceptual motor learning and SoA [15].

In addition, with regard to voluntary action and motivation, the concepts of voluntary action and goal-directed action are similar in many aspects, and the theory of goal-directed action has been presented to explain voluntary action [16]. The subjective experience of agency has been shown to be influenced by motivational (goals) and instrumental (action-selection) processes [16]. In addition, Synofzik et al. [17] explained that predictive components, such as the affective, sensorimotor, and cognitive levels (including emotion and reward), and postdictive components lead to self-agency. However, these convincing theories can be explained by healthy people. Because of impairments in instrumental (action-selection) processes, the subjective experience of agency is unlikely to occur in stroke patients, even if they are motivated. Therefore, in order to investigate the relationship between motivation and SoA in this study, we relied on the premise that motivation is affected by the activation of reward systems. This is explained by the reward-prediction error hypothesis rather than by the theory of goal-directed action. Therefore, this study tested the hypothesis that nursing support for patient independence, as previously identified [11], would increase SoA and improve motivation by causing positive errors in the patient’s self-predicted SoA.

In Japan, KANSEI is defined as “the function of the mind derived from various senses.” The idea for the present study arose from the notion that one of the roles of healthcare professionals is to stimulate the patient’s KANSEI; in other words, “stimulate the patient’s various senses and increase their motivation to recover.” SoA is one of the patient’s senses, and we wanted to examine the usefulness of nursing intervention for SoA. Moreover, this investigation was conducted to obtain further insights to guide nursing involvement for improving the patient’s SoA and motivation for rehabilitation.

2. METHODS

2.1 Patients

Inpatients undergoing rehabilitation at the X Hospital, a specialized rehabilitation institution, were screened and patients who met the following four requirements were included in the analysis: 1) ≤ 6 months since the onset of cerebrovascular disease; 2) no cognitive function impairment, capable of communication, and no impairment of activities of daily living on an objective assessment by the attending physician; 3) ongoing participation in any rehabilitative exercise for at least 1 month; and 4) improvement in the functional independence measure (FIM) score from the beginning of rehabilitation to the time of study assessment. From among the patients who expressed an intent to participate, 25 patients who met the requirements based on the assessment of the attending physician or a certified stroke nurse in the relevant hospital ward were selected for inclusion in this cross-sectional study conducted between August 2017 and September 2018.

2.2 Survey Content

The following information was gathered during the survey:

1) Basic attributes: sex, age, disease, time since onset, and duration of rehabilitation.

2) Measurement of patient motivation: We used the Apathy Scale, which was created by Starkstein et al. [18] and translated into the Japanese version by Okada et al. [19], to evaluate the loss of motivation in patients with cerebrovascular disease. The scale contains 14 questions, of which the first eight cover positive symptoms related to motivation and interest and the remaining six questions cover negative symptoms. Patients answered each question by selecting one of four responses (i.e., not at all, slightly, some, a lot), and each response was scored 0–3, respectively.

3) Measurement of SoA: The SoA was measured with the Embodied Sense of Self Scale (ESSS) created by Asai et al. [20]. The ESSS measures self-representation at the sensory level and is based on identity and personality. It contains 25 questions that assess the following three factors of self-representation: agency (eight questions), narrative (eight questions), and ownership (nine questions). Self-representation comprised two elements: minimal self and narrative self. The minimal self encompasses both SoA and SoO [12]. All of the included factors are strongly related and contribute to the establishment of the self [20].
used the ESSS scale to examine the SoA at the sensory level, based on the narrative self. Patients answered each question by indicating one of the following five responses: strongly disagree (1 point), somewhat disagree (2 points), neither disagree nor agree (3 points), somewhat agree (4 points), and strongly agree (5 points).

4) Degree of nursing support for agency: Based on the nursing support that is expected for agency, which was ascertained in a survey by Murayama et al. [11], a seven-question survey was created to assess the degree of implementation of support (Table 1); each question was answered through one of the following four responses: not at all (0 points), a little (1 point), somewhat (2 points), and a lot (3 points).

2.3 Data Collection

Patients who were capable of completing the questionnaire were provided with a questionnaire and asked to deposit the completed questionnaire into a collection box that was placed in the hospital ward. The questionnaires in the box were gathered by the researchers at a later date. Four patients faced difficulties in answering the questionnaire due to paralysis or vision loss; in these cases, the research assistants read out the questions and asked the patients to answer them orally, and the responses were transcribed by the research assistants into the questionnaire.

2.4 Data Analysis

To understand the basic attributes of the patients, descriptive statistics were used for attribute variables. To analyze the factor structure of the seven forms of nursing support for agency, a factor analysis (maximum-likelihood method, promax rotation) was undertaken and a confidence coefficient was calculated for each factor. The relationship between each factor and the SoA and apathy score (motivation) was determined by using Pearson’s product–moment correlation coefficient. Finally, a covariance structure analysis was developed to test a model wherein each factor affects motivation via the SoA. The goodness-of-fit was determined using the $\chi^2$ value, root mean square error (RMSER), and comparative fit index (CFI). All analyses were conducted in SPSS ver. 24.0 and Amos 25 statistical software (IBM, Armonk, NY). A 5% significance level was used.

2.5 Ethical Considerations

This study’s protocol and the study-site application were submitted to the hospital’s educational research committee, and approval for the study from the Institutional Ethics Review Board (FY 2017, approval number 15) was obtained prior to the initiation of research procedures. Study participants were provided a thorough explanation, both orally and in writing, of the purpose and significance of the study, study procedures, and ethical considerations. In addition, we explained that consent could be withdrawn at any time during the study. The survey included only patients who provided written informed consent by signing a study consent form.

3. RESULTS

3.1 Patient Attributes

The 25 study participants included 20 males (80.0%) and five females (20.0%), and the mean age, mean time from stroke onset, and mean duration of rehabilitation was $61.6 \pm 12.8$ years, $2.37 \pm 0.49$ months, and $1.67 \pm 0.64$ months, respectively, in this study population. The characteristics of the study participants are presented in Table 2.

| Attribute               | Category                  | No. | (%)  |
|-------------------------|---------------------------|-----|------|
| Sex                     | Male                      | 20  | (80.0) |
|                         | Female                    | 5   | (20.0) |
| Disease                 | Cerebral infarction       | 15  | (60.0) |
|                         | Cerebral hemorrhage       | 10  | (40.0) |
| Time since occurrence   | < 2 months                | 2   | (8.0)  |
| (months)                | < 3 months                | 13  | (52.0) |
|                         | < 4 months                | 10  | (40.0) |
| Duration of rehabilitation | < 1 month                | 5   | (20.0) |
| (months)                | < 2 months                | 12  | (48.0) |
|                         | < 3 months                | 8   | (32.0) |

n = 25
3.2 Degree of Patient Motivation
The higher the total apathy score, the greater the motivation loss. The mean apathy score in this study was 11.2 ± 5.4, and a score ≥ 16 points was associated with loss of motivation, which was observed in seven patients (28.0%); however, motivation was noted in the remaining 18 patients (72.0%).

3.3 Factor Structure of Seven Forms of Nursing Support for Agency
Factor analysis (maximum-likelihood method, promax rotation) was carried out to identify the factors that comprise nursing support for agency (Table 3). Forms of support with a factor loading of 0.40 or higher were used and a cumulative contribution ratio of 44.60% resulted in the extraction of two factors. Factor 1 was interpreted in relation to nursing explanations, such as “explain whether or not an action should be performed alone,” and was called “proper explanation of treatment.” Factor 2 was interpreted in relation to the instillation of the feeling that the patient is the agent of their own actions, such as “provide verbal indication of progress on training items done in preparation for independence” and “ask how [the patient] wants to do things,” and was called “involvement that ascribes patients with agency of action.” The Cronbach α coefficient was 0.64 and 0.58 for Factors 1 and 2, respectively. Despite the rather low α coefficient, the abovementioned factors were used in the analysis as their reliability was confirmed to a certain extent.

3.4 Reliability of SoA and Apathy Score (Motivation)
Alpha coefficients were calculated to investigate the internal consistency of SoA and the apathy score (motivation), and were 0.82 and 0.80 for the SoA and apathy score (motivation), respectively, which confirmed the reliability of the scales used in this study.

3.5 Relationship between Each Factor, SoA, and Apathy Score (Motivation)
The correlation coefficients for motivation, SoA, and nursing support for agency (Factor 2) are shown in Table 4. Only Factor 2, that is, nursing involvement that ascribes patients with the agency of an action, correlated with the SoA (p < .01). Furthermore, a correlation between SoA and motivation was noted (p < .05).

Subsequently, we created a model wherein nursing support for agency affected motivation through the patient’s SoA, and a covariance structure analysis was undertaken by using Amos to test the model. The score for four forms of support was designated as an observed variable, and a causal model was created on the basis of the hypothesis. The analytical results of the causal model are shown in Fig. 1, and the indicators of the model’s goodness-of-fit were $\chi^2 = 3.625$, df = 3, $p < .163$, RMSE = 0.095, and CFI = 0.908. We proceeded with the analysis after the results were evaluated to indicate the acceptability of the causal model. There was a significant difference in the causal relationship between Factor 2 and

### Table 3: Factor structure of nursing support for agency

|                      | Factor 1 | Factor 2 |
|----------------------|----------|----------|
| Factor 1: Proper explanation of treatment (α = 0.64) |          |          |
| 1. Explain whether or not an action should be performed alone. | 1.035    | -0.405   |
| 7. Explain whether rehabilitation is currently performed properly or not. | 0.714    | 0.521    |
| 2. Explain rehabilitation during the early period of hospitalization. | 0.226    | 0.078    |
| Factor 2: Involvement that ascribes patients with agency of action (α = 0.58) |          |          |
| 3. Provide verbal indication of progress on training items in preparation for independence. | -0.014   | 0.550    |
| 4. Ask how things are coming along with the patients readiness for discharge. | 0.276    | 0.481    |
| 5. Ask how patients want to do things. | 0.056    | 0.450    |
| 6. Incorporate opinion when proposing the proper method of rehabilitation. | -0.164   | 0.423    |

Correlation between factors

|                      | Factor 1 | Factor 2 |
|----------------------|----------|----------|
| Factor 1             | –        |          |
| Factor 2             | 0.428    | –        |

Factor extraction method: maximum likelihood method, rotation method: promax rotation involving Kaiser normalization. Factor loading used is shown in bold rectangles.

### Table 4: Correlation between motivation, sense of agency, and nursing support for a patient’s agency (two factors)

|                      | Motivation | Sense of agency | Involvement that ascribes patients with agency of action |
|----------------------|------------|-----------------|--------------------------------------------------------|
| Sense of agency      | 0.665*     | –               | –                                                      |
| Involvement that ascribes patients with agency of action | -0.396 | -0.884** | –                                                      |
| Proper explanation of treatment | -0.373 | -0.429 | 0.243                                                  |

*n = 25, *p < .05, **p < .01
The Relationship between Motivation for Rehabilitation and Sense of Agency in Patients with Cerebrovascular Disease, and Nurse Support for Patient Agency

4. DISCUSSION

4.1 Relationship between SoA and Motivation

This study revealed a possible relationship between patient motivation and SoA in the clinical setting and suggested that attempting to stimulate the patient’s KANSEI, i.e., the provision of nursing support for patient independence, improves the patient’s SoA and motivation.

In this study, based on the apathy score, we found that 72% of the participants were found to be motivated. In a previous study [19] that surveyed 135 stroke patients, loss of motivation was observed in approximately half of the patients. In the present study, patients felt that their symptoms improved after commencing rehabilitative training; moreover, based on an increase in the mean FIM score of 52.5% ± 36.7%, only a few patients experienced loss of motivation.

The challenge with studying the SoA is vested in the fact that the SoA is not even consciously registered in healthy people. Therefore, studies of SoA have been conducted in schizophrenic patients because of the extent of knowledge that is available on abnormal feelings of self-subjectivity and the confirmed accuracy of the ESSS in studies in these patients [20]. However, the ESSS was actually developed to target a broader subject and has a potential for use in the investigation of the SoA even in individuals who are not schizophrenic. At present, there are no reports that have examined in detail whether the ESSS is indicated for assessment in stroke patients.

However, because abnormalities in the SoA, such as the feeling of a lack of ownership of the responses to upper and lower limb movements on the paralyzed side, are frequently observed in stroke patients, we considered that assessment with the ESSS would be useful for determining the objectives of our study. The ESSS values of stroke patients in the present study (data not shown) were similar to those reported for healthy individuals and amputees by Asai et al. [20]. Thus, there were no abnormalities in the ESSS values, unlike that in schizophrenic patients. It is possible that the ESSS values, including the SoA, have improved to the level of these parameters in healthy people, because our study participants were individuals whose motor function was improved by rehabilitation. However, the results of this study are based on the assumption that the SoA is reflected in the ESSS, and further studies are needed to understand the indication for ESSS in stroke patients as well as the actuality and changes of the SoA.

We anticipate that the causal relationship between SoA and motivation will be described in future studies, because the firsthand experience of several clinicians includes a sequence of events wherein a slight foot movement or similar development is a springboard (for improved SoA), which is followed by improved patient motivation for rehabilitation. The abovementioned causal relationship may be related to the activation of the reward system in the brain (reward-prediction error hypothesis), which occurs when the outcomes of an intentional action are better than predicted, and leads to the next rewarding action (increased motivation).

Our investigation of the effect of SoA on motivation confirmed that SoA has a positive effect on motivation. SoA is the subjective view of oneself to effect action, and internal motor control is reported to be involved in developing an SoA [21]. Internal motor control is described as the adjustment of one’s movement toward an intended

SoA (path coefficient = -0.83, coefficient of determination $R^2 = 0.83$, $p < .001$) and between SoA and motivation (path coefficient = 0.83, coefficient of determination $R^2 = 0.44$, $p < .01$).

Figure 1: Relationship between motivation, sense of agency, and nursing support for a patient’s agency

Data shown are standardized estimates

**$p < .01$, ***$p < .001$,
movement with a forward model and sequential (sensory information being intermittently fed back) feedback model of proprioceptive sensation and visual feedback. The SoA is suggested to result from the coordination of the forward model and sequential feedback model [22]. In this study, the patients experienced some recovery of motor function due to rehabilitative exercises, and we presumed that the SoA improved in these patients with the recovery of their internal motor control. Thus, the results of this study suggest that an enhanced subjective view of self-ownership of the control over the body results in increased motivation. Indeed, in schizophrenic patients who feel that their own bodies are being manipulated by others, a positive correlation between loss of SoA and anxiety traits has been shown, suggesting that patients with unstable SoA may be more likely to experience depressed mood and anxiety (negative symptoms) [23]. Similarly, it may be possible to speculate that stroke patients who felt that a part of their body did not belong to them experienced an improvement in depressed mood and anxiety levels with the stabilization of the SoA, which led to a recovery of motivation.

4.2 Nursing Involvement that Increases SoA

Of the two factors identified in this study, Factor 2 was significantly related to SoA. In Factor 2, nursing involvement includes the presumption that the patient is the agent of their own actions and that the event could have been triggered by the patient’s actions. Synofžík et al. [24] presented a two-step account of internal motor control: the first step comprises a feeling of agency at a nonconceptual and sensorimotor level and the second step comprises judgment of agency at a conceptual level. The conceptual judgment of agency is a process that involves a cognitive dimension of brain function that decides whether agency of action lies within oneself, based on intention, belief, and circumstantial context [24]. In healthy people, sensory outcomes match the sequential feedback in the internal motor control, and the person naturally experiences self-agency of their action. In patients undergoing rehabilitation, we could assume that this process does not operate effectively because of paralysis or other symptoms, thereby weakening the patient’s SoA. Furthermore, Spengler et al. [25] demonstrated that, when a mismatch is detected between the forward model and consecutive model, a cognitively speculative process occurs that is related to a conceptual judgment on SoA. In patients with cerebrovascular disease, this process is affected by the patient’s condition. Therefore, nursing involvement that promotes SoA among patients may act at a cognitive level to assist the patient in making their conceptual judgment of their SoA. Furthermore, Casper et al. [26] reported that coercion from others can decrease the SoA, indicating that the coercive guidance and non-consensual care that healthcare providers tend to undertake for patients with decreased SoA can further decrease the patient’s SoA. Therefore, in nursing that promotes patient autonomy, care should not be provided against the patient’s will, and suggests that involvement which respects the patient’s autonomy is necessary. Nevertheless, to foster an SoA in patients, supportive involvement must be continued in the long term; moreover, for patient agency to improve, the support should allow patients to solve problems themselves in order to eventually become capable of overcoming issues through their own capacity, although this may take a long time. However, stable long-term support cannot be achieved solely by nursing interventions for patient agency. Therefore, a holistic approach that includes the creation of a relaxing environment, provision of moral support, and building a relationship of trust is required.

4.3 Influence of SoA and Motivation on Effectiveness of Motor Learning

Several studies on the positive effects of motivation on motor learning, which is one of the goals of rehabilitation therapy, have been conducted [27-31]. The basis for motivational drive is an intracerebral system of reward that principally involves dopamine neuron systems, which are activated by physiological rewards, such as food, and, recently, by social rewards, such as praise and monetary rewards [32-34]. Using praise to drive patient motivation could be incorporated into clinical practice, and specific strategies that utilize praise should be developed in the future. A study that investigated the effect of SoA on motor performance [14] revealed that muscle activity decreases as the SoA decreases. In addition, Morioka et al. [15], who examined the association between intentional binding (IB) and perceptual motor learning, discussed motor progression and SoA by inferring a reward system in relation to it, and described the possibility that a positive predictive error (activation of the reward system) on the outcome of motor learning could enhance SoA. As the present study did not measure changes at the physiological level, we can only speculate on the possibility of an association between the results of the present study and the reward system on which motivation is based. Although the SoA inferred from the IB and the SoA that is speculated from the ESSS cannot be considered to be the same, the positive feedback by nurses to the SoA in this study may have led to the
generation of the patient’s SoA and the activation of the reward system. The activation (motivation) of the reward system will lead to resultant purposeful rehabilitation, which will further enhance the SoA and motor-learning effects. It is assumed that the nurse’s involvement can lead to increased effectiveness of rehabilitation by getting the patient into the rehabilitative cycle.

4.4 Strengths and Limitations

In this study, we attempted to reduce the influence of exogenous variables and implemented a condition control for subjects who had cleared many conditions at a single hospital specializing in rehabilitation. Thus, the analysis included only 25 samples extracted over a year. To prove the validity of the results, further research with larger samples is required. In addition, some patients with cerebrovascular disease in this study population were unable to complete the questionnaire on their own. The research assistants were able to provide support for completion of the questionnaire; however, because the questionnaire describes subjectivity, there may have been changes in the content of the answers due to the intervention of others. In addition, we used the ESSS as an SoA indicator, but it is important to fully examine whether the ESSS can be a truly appropriate indicator for stroke patients in the future. It is necessary to investigate the relationship between the SoA and rehabilitation effects in stroke patients.

5. CONCLUSIONS

Interventions to motivate patients with cerebrovascular disease to participate in rehabilitation is vital in order to improve the prognosis. In this study, we examined the usefulness of nursing interventions to stimulate the patient’s KANSEI; in other words, to “stimulate the patient’s SoA and increase their motivation to recover.” This study suggests that nursing interventions to the patient’s SoA may play an effective role in motivating the patient. Nursing interventions for the patient’s SoA may work positively for the patient through: (1) helping the patient’s SoA conceptual judgment effected by cognitive effort, (2) enhancing SoA by avoiding coercive involvement that reduces autonomy and fostering a sense of autonomy, and (3) positive feedback to the SoA, “telling the patient that they are moving autonomously” causes positive predictive errors and activates the reward system. It can be assumed that this involvement will lead to an increase in rehabilitative motivation by increasing the SoA, and that proactive activities as a result of improving motivation will lead to further generation of SoA.

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