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# Development of the Adapted Physician Centrality Scale : A Cross-sectional Study in Japan

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*ABSTRACT*

Background : Physician centrality might have an adverse effect on interprofessional collaboration. However, no scale has been developed to assess physician centrality in Japan.

The aim of this study was to develop the Adapted Physician Centrality Scale, a Japanese version of the physician centrality subscale of the Attitudes Toward Health Care Teams Scale, and to verify its internal consistency and structural validity.

Methods : We conducted a cross-sectional study using a self-administered questionnaire. The internal consistency was examined with Cronbach's alpha coefficient. Confirmatory factor analysis was also conducted to estimate the degree of statistical fitness for the factor structure.

Results : Of 487 full-time nurses, 307 (288 female, 17 male, and 2 of unknown sex ; mean age ± standard deviation : 31.5 ± 9.68 years) participated in the study. After two items were deleted, the Adapted Physician Centrality Scale had internal consistency (Cronbach's alpha, 0.63) similar to that of the physician centrality of the Attitudes Toward Health Care Teams Scale (0.68). Confirmatory factor analysis revealed an acceptable level of statistical fit (standard root mean square residual≤0.09, comparative fit index≥0.96).

Conclusions : We developed the Adapted Physician Centrality Scale and found that it has acceptable internal consistency and structural validity for measuring physician centrality in Japan.

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Key words : interprofessional collaboration, Attitudes toward Health Care Teams Scale, relationship between nurses and physicians, confirmatory factor analysis

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## INTRODUCTION

Interprofessional collaboration between multiple health care providers and professions frequently occurs in health care settings to ensure that comprehensive services are provided to patients, families, caregivers, and communities[1]. Interprofessional collaboration enables effective collaborative practice that promotes optimal health care services, systems, and outcomes[2].

However, as pointed out by Heinemann et al., physicians are often considered to exert a strong influence and hold a central position over the organization of the team itself[3]. This centrality of physicians might have an adverse effect on interprofessional collaboration. For example, when nurses and physicians work toward treatment goals, conflicts are a common problem[4]. Interprofessional collaboration can lead to conflict when team members have different views and opinions about priorities and patient care planning. In particular, issues regarding the authority of physicians contribute to conflict between physicians and other medical professionals and hinder conflict resolution[5].

In health care environments characterized by a hierarchical culture, physicians are at the top of that hierarchy, in a dominant position. Hierarchical differences can diminish the collaborative interactions necessary for providing the appropriate treatment[6,7]. Physicians also serve as the gatekeepers and managers of the team and make decisions about the admission and discharge of patients. They also have a strong influence on the organization of the team itself[3]. In Japan, it has been argued that having physicians at the top of the hierarchy affects formal interprofessional collaboration[8].

Particularly in Japan, the job of the nurse, as defined by the 1948 Act on Public Health Nurses, Midwives, and Nurses (Act No. 203), is to assist in the medical treatment and care of injured people. Moreover, medical practice performed by nurses as an assistant needs to be carried out under the direction of a physician[9]. Furthermore, the 1948 Medical Care Act (Act No. 205) stipulates that the directors of hospitals and clinics be physicians[10]. Hosoda stated that health care workers other than physicians are legally forced to depend on physicians in terms of both their duties and their position as a professional[11]. A medical paternalism model with physician centrality therefore still legally exists in Japan. However, the complexity of medical care has increased because of rapidly advancing scientific knowledge. This requires physicians to collaborate with many other healthcare professionals[12].

The Attitudes Toward Health Care Teams Scale (ATHCTS) was developed in 1999 by Heinemann et al. to measure the interprofessional collaboration of medical staff[3]. This scale includes two subscales : Quality of Care/Process (14 items) and Physician Centrality (six items). The collegiality of team interaction in health care teams is related to patient outcomes. Physician attitudes are considered particularly important in determining the quality of team functioning[13]. The concept of physician centrality was therefore added to this scale. Respondents who have scored high on this scale feel that physicians should be both the team leader and the primary decision-maker. Those who have scored low feel that leadership and responsibility should be more widely shared among the team[3]. A Japanese version of the ATHCTS's "Quality of Care/Process" subscale has been developed by Yamamoto et al., and its reliability and validity have been verified[14]. However, to date, the ATHCTS's "Physician Centrality" subscale has not yet been translated into Japanese. The development of a scale that can measure physician centrality is necessary to promote interprofessional collaboration and therefore improve outcomes for patients.

To evaluate the relationship between interprofessional collaboration and physician centrality in Japan, where physician centrality is presumed to be strong, a Japanese version of the ATHCTS's "Physician Centrality" subscale with verifiable reliability and validity needs to be developed. The medical systems differ between the United States and Japan, and, ideally, this difference requires a scale specifically designed for Japanese medical professionals. However, because a scale to measure physician centrality is not yet available in Japan, we decided to take the first step by translating a physician centrality subscale developed in the United States.

Therefore, in the present study, we developed a Japanese version of the ATHCTS's physician centrality subscale, which the authors of the ATHCTS called the "Adapted Physician Centrality Scale," through a process of translation into Japanese, back-translation into English, and cognitive interviews. Then, to evaluate the scale's internal consistency and structural validity, we calculated Cronbach's alpha coefficient and performed confirmatory factor

analysis with structural equation modeling.

## Methods

*Development of the Adapted Physician Centrality Scale and evaluation of content validity*

The translation process into Japanese followed the World Health Organization process of translation and adaptation of instruments and the International Society for Pharmacoeconomics and Outcomes Research Task Force for Translation guidelines[15,16]. Permission for translating the scale was obtained from its authors. The primary author (RH) of the present study translated the English-language ATHCTS's "Physician Centrality" subscale into Japanese. During the translation process, care was taken to use natural Japanese expressions that could be easily understood by respondents without meanings being altered. The translated version of the ATHCTS's "Physician Centrality" subscale was considered complete after the initial translation was reviewed and modified by graduate students and physicians and nurses working at a medical college. A bilingual English-language physician (DH) back-translated the completed Japanese version into English without knowledge of the ATHCTS.

We asked the original authors of ATHCTS to check the back-translated version of the scale and to confirm that its meaning and content were identical to those of the ATHCTS. Following the authors' confirmation, the prototype version of the Adapted Physician Centrality Scale was complete.

To identify any translation problems that had gone unnoticed and to examine the ease of understanding and cognitive equivalence of the Japanese version of the scale for potential respondents, cognitive interviews were then conducted. Because core teams in health care consist of nurses, physicians, and social workers[3], the interview participants in the present study were nurses, so that it could focus on physicians and nurses, who are considered to work most closely together. The cognitive interviewees were 10 nurses who were working full-time at an inpatient ward or an outpatient department of The Jikei University Hospital, a 1075-bed facility in Minato ward, Tokyo. All participants were selected with convenience sampling to diversify sex, age, and department ; furthermore, all participants provided written informed consent before the study began. The nurses answered the prototype version of the Adapted Physician Centrality Scale and then participated in interviews conducted and recorded by the primary author of the study (RH). The interviews included questions regarding whether the nurses knew the meanings of all the words and whether they could ask what they thought, repeat things in their own words, and understand all the questions. The protocol for the cognitive interview stage was approved by the Ethics Committee of The Jikei University School of Medicine for Biomedical Research (28-338 (8581)).

*Internal consistency and structural validity of the Adapted Physician Centrality Scale*

Study design, setting, and participants

We conducted a cross-sectional, self-administered questionnaire survey at The Jikei University Daisan Hospital (hereafter Daisan Hospital), a 581-bed facility with 487 full-time nurses in Komae, a city approximately 18 km west of central Tokyo. The surveyed nurses were from 12 departments in December 2017 and from the other seven departments in January 2018. The survey periods were divided into two phases because a limited number of lockboxes were available for the respondents. Each survey period lasted 2 weeks.

Distribution and collection method

Questionnaires were distributed from the nursing department through each head nurse. Lockboxes for questionnaire collection were installed in each department.

All full-time nurses who worked at Daisan Hospital were asked to participate in the study on their own free will basis. Information about the study was disseminated by placing posters in each department that was conducting the survey. The following was clearly stated on the cover of each questionnaire : "This survey is being conducted for research purposes only, participation is voluntary, you can withdraw from the survey at any time without penalty, and you do not have to respond to any question you do not wish to answer. Posting this questionnaire to the lockbox is considered to indicate consent to participate in the study. Because this is an anonymous questionnaire survey, you cannot withdraw the research agreement after posting the questionnaire." The protocol for this questionnaire survey was approved by the Ethics Committee of The Jikei University School of Medicine for Biomedical Research (29-

164(8780)).

*Evaluation items*

The Adapted Physician Centrality Scale

The ATCHTS was developed to measure a team member's attitude toward a team composed of different professions[3]. The scale consists of two subscales : "Quality of Care/Process" (14 items) and "Physician Centrality" (six items). All items are ranked on a six-point Likert scale ranging from 0 (strongly disagree) to 5 (strongly agree). Evaluated in the present study was the Adapted Physician Centrality Scale, a Japanese-translated version of the ATCHTS's "Physician Centrality" subscale.

Participants' backgrounds

Full-time nurses working at Daisan Hospital were asked about their sex, age, and current workplace (medical ward, surgical ward, outpatient department, central medical department, or other). The central medical departments at Daisan Hospital are the Radiation Therapy Unit, Endoscopy Unit, Intensive Care Unit, Surgery Unit, and Tumor Center. Other departments are the Medical Safety Promotion Department, Infection Control Unit, Palliative Care Team, and Bedsore Countermeasure Team.

*Sample size*

In structural equation modeling used to evaluate validity, 100 or more samples are needed to infer appropriate fitness[17]. To ensure that 100 or more samples were collected, including a high number from each department, and the diversity of the sample, questionnaires were distributed to all 487 full-time nurses working at Daisan Hospital.

*Analysis methods*

Definition of incomplete data

Only responses with no missing data other than sex were included in the analysis.

Evaluation of internal consistency

The internal consistency of the Adapted Physician Centrality Scale was examined with Cronbach's alpha coefficient. If the value of Cronbach's alpha was insufficient, we examined the item–rest correlation, which is the correlation between each item score and the total score of the other items. Items with an item–rest correlation $<0.20$ were excluded because of the low homogeneity of the scale[18].

Evaluation of structural validity

To estimate the degree of statistical fitness for the factor structure of the Adapted Physician Centrality Scale, we conducted confirmatory factor analysis using structural equation modeling and evaluated structural validity. The ATHCTS's "Physician Centrality" subscale has a one-factor structure. The fitness indices of the Adapted Physician Centrality Scale were determined and compared. On the basis of previous research, good model fit was defined as a standard root mean square residual (SRMR)$\leq$0.08, comparative fit index (CFI)$\geq$0.95, Tucker–Lewis Index (TLI)$\geq$0.95, and root mean square error of approximation (RMSEA)$\leq$0.06 as criteria for a single index[19,20]. We also applied the criteria for a combination of SRMR$\leq$0.09 and CFI$\geq$0.96[19]. All statistical analyses were performed with the software program Stata 14 (StataCorp, College Station, TX, USA). Values of $P<0.05$ were considered to be statistically significant.

Patient and public involvement

No patients were involved in the research planning or interpretation of results. The participating nurses who were interviewed at the cognitive interview stage checked the content of the questionnaire. The author MG met the inclusion criteria of participants at the validation stage but did not respond to the questionnaire ; therefore, her response did not affect the results of study. We plan to report the summary results to the research participants of the validation stage.

## RESULTS

*Development and content validity of the Adapted Physician Centrality Scale*

The participants in the individual cognitive interviews were 10 full-time nurses (nine female and one male ; mean age : 34.4 years ; age range : 23–46 years). In total, 30 opinions were raised by these nurses. The main terms noted as being difficult to understand were the phrase "health care teams" in item 4 ("The physician should not always have the final word in decisions made by health care teams.") and the word "natural" in item 6 ("Physicians are natural team leaders."). We therefore discussed changing

the wording of the scale with the authors of the ATCHTS. The phrase "health care teams" in item 4 was changed to "teams," and the sentence in item 6 was changed to "The physician is certainly a team leader." The new item 6 was back-translated into English ("The physician is certainly a team leader.") by the bilingual English-language doctor (DH) and sent to the ATHCTS authors for confirmation. The ATHCTS authors pointed out that the meaning of this item differed from the original scale. They also noted that the meaning of "teams" in the revised question 4 would change if the words "health care" were removed. The wording of both questions was therefore left unchanged, and the final version was completed. The initial translated version was named the Adapted Physician Centrality Scale by the authors of the ATHCTS.

Table 1. The basic attributes of participants ($n$=307)

| Variable | Category | $n$ (%) |
|---|---|---|
| Sex | Female | 288 (93.8) |
| | Male | 17 (5.5) |
| | Unknowns | 2 (0.7) |
| Age, years | ≤ 29 | 173 (56.4) |
| | 30−39 | 66 (21.5) |
| | 40−49 | 46 (15.0) |
| | ≥ 50 | 22 (7.2) |
| Workplace | Medical wards | 89 (29.0) |
| | Surgical wards | 86 (28.0) |
| | Outpatient departments | 61 (19.9) |
| | Central medical departments | 65 (21.2) |
| | Other | 6 (2.0) |

Central medical departments : Radiation Therapy Unit, Endoscopy Unit, Intensive Care Unit, Surgery Unit, and Tumor Center
Other : Medical Safety Promotion Department, Infection Control Unit, Palliative Care Team, and Bedsore Countermeasure Team

*The internal consistency of the Adapted Physician Centrality Scale*

Of the 487 full-time nurses working at Daisan Hospital who were invited to participate, 342 completed the questionnaires. After 35 questionnaires with at least one missing value in the scores were excluded, 307 questionnaires were included in the analysis (participants : 288 female, 17 male, and 2 of unknown sex ; mean age ± standard deviation [SD] : 31.5 ± 9.68 years). Table 1 shows the basic attributes of participants. The numbers of nurses at workplaces were as follows : a medical (internal medicine) ward, 89 ; a surgical ward, 86 ; an outpatient department, 61 ; a central medical department, 65 ; and other, six.

The descriptive statistics of the items are shown in Table 2. The internal consistency (Cronbach's alpha) of the Adapted Physician Centrality Scale was insufficient (0.40). To identify the reason for the low Cronbach's alpha value, we examined the item–rest correlation, the results are shown in Table 2. According to Kline, items with an item–rest correlation <0.20 should be excluded because of the low homogeneity of the scale[18]. As shown in Table 2, items 3 and 4 were −0.10 and 0.04, respectively. Following this criterion, we removed these items. As a result, Cronbach's alpha for the Adapted Physician Centrality Scale increased to 0.63. After deleting the two items with low item–rest correlations, we performed the item–rest correlations again. All the remaining items had values between 0.38 and 0.46 (Table 3).

*Structural validation of the four- and six-item versions of the Adapted Physician Centrality Scale*

Confirmatory factor analysis showed that all indices in-

Table 2. Item analysis and item–rest correlation analysis of the Adapted Physician Centrality Scale

| Item | Mean | SD | Item-rest correlation |
|---|---|---|---|
| 1 : "Physicians have the right to alter patient care plans developed by the team" | 2.73 | 0.95 | 0.26 |
| 2 : "A team's primary purpose is to assist the physician in achieving treatment goals for patients" | 2.08 | 1.11 | 0.31 |
| 3 : "Physicians, as a rule, are team players"[a] | 1.88 | 0.99 | −0.10 |
| 4 : "The physician should not always have the final word in decisions made by health care teams"[a] | 1.66 | 0.81 | 0.04 |
| 5 : "The physician has the ultimate legal responsibility for decisions made by the team" | 2.99 | 1.02 | 0.28 |
| 6 : "Physicians are natural team leaders" | 2.50 | 1.01 | 0.37 |

$n$=307 ; [a], reversed items ; SD=standard deviation

Table 3. Item–rest correlation analysis of the Adapted Physician Centrality Scale (after items 3 and 4 deleted)

| Item | Item-rest correlation |
|---|---|
| 1 : "Physicians have the right to alter patient care plans developed by the team" | 0.42 |
| 2 : "A team's primary purpose is to assist the physician in achieving treatment goals for patients" | 0.40 |
| 5 : "The physician has the ultimate legal responsibility for decisions made by the team" | 0.38 |
| 6 : "Physicians are natural team leaders" | 0.46 |

$n$=307

Table 4. Results of confirmatory factor analysis of the Adapted Physician Centrality Scale

| Factor model | Comparative fit index (CFI) | Tucker–Lewis Index (TLI) | Root mean square error of approximation (RMSEA) | Standard root mean square residual (SRMR) |
|---|---|---|---|---|
| Model 1 : six items | 0.79 | 0.66 | 0.12 | 0.07 |
| Model 2 : four items | 0.97 | 0.91 | 0.08 | 0.03 |

$n$=307

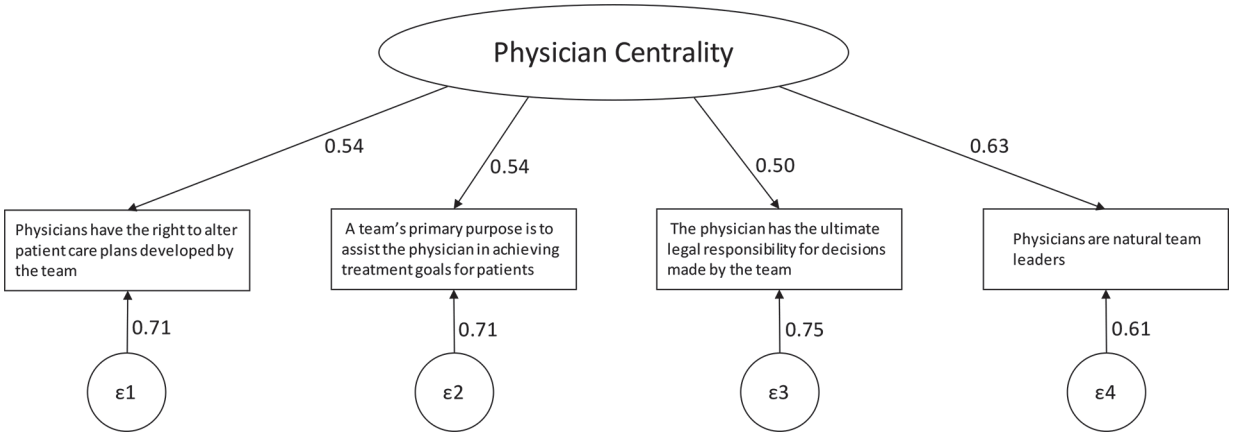


Fig. 1. Confirmatory factor analysis of the four-item Adapted Physician Centrality Scale

dicated that the fitness of the four-item version was superior to that of the six-item version (Table 4). Although RMSEA and TLI did not satisfy the criteria for a single index, the criteria were met by SRMR and CFI. A combination of SRMR and CFI also demonstrated acceptable fitness (SRMR≤0.09, CFI≥0.96)[19]. Hu and Bentler recommended using a combination of CFI and SRMR goodness-of-fit criteria if the sample size was small (N≤250), which was close to the sample size used in this study[19]. The results of the confirmatory factor analysis of the four-item version are shown in Figure 1.

Figure 2 shows a histogram of the Adapted Physician Centrality Scale (four items). The mean ± SD score among participants distributed between 0 and 17 was 10.30 ± 2.83 (95% confidence interval [CI] : 9.99–10.61).

## DISCUSSION

The aim of the present study was to develop, and assess the internal consistency and structural validity of, a Japanese version of the Adapted Physician Centrality Scale. As a first step, in accordance with known guidelines, we developed a Japanese-translated six-item prototype version of the "Physician Centrality" subscale of the ACHCTS. On the basis of Cronbach's alpha coefficient and the item–rest correlation, the four-item version was found to be superior to a six-item version. Confirmatory factor analysis indicated

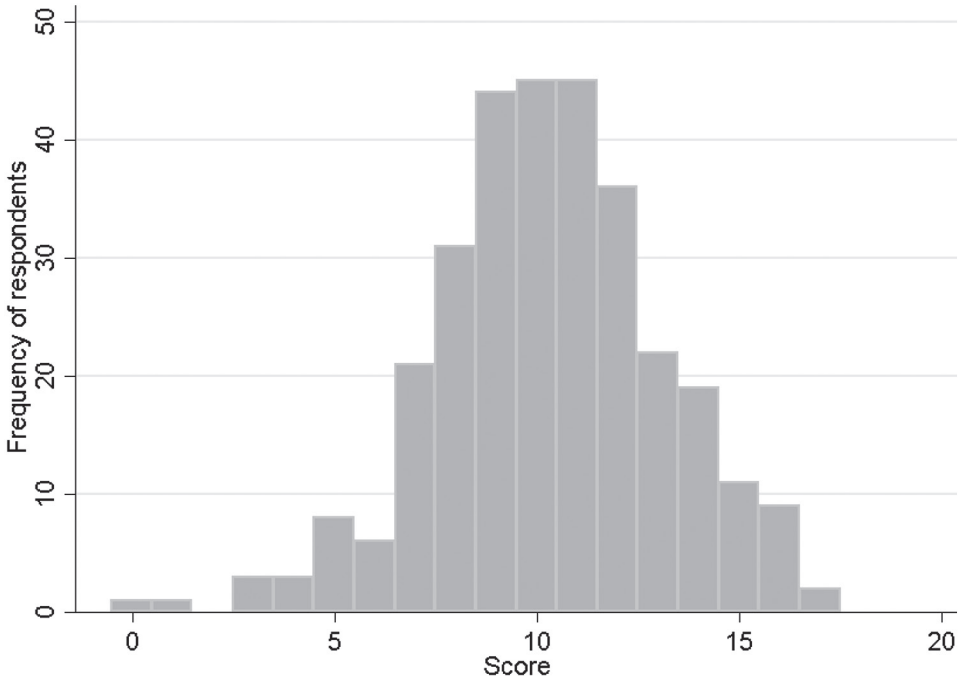


Fig. 2. Distribution of scores on the four-item Adapted Physician Centrality Scale ($n$=307)

that the four-item scale with a one-factor structure had better goodness of fit than did the six-item version. For the goodness of fit of the four-item scale, moreover, a combination of SRMR and CFI was at a sufficient level.

Two reversed items were excluded because of low item–rest correlations. Reversed items have the merit of being able to control acquiescence response bias in questionnaire studies[21]. However, a problem may arise such that a factor consists of only reversed items, or the internal consistency of the scale may be reduced[22]. In addition, reversed items may cause wrong answers due to such reasons as neglect of negative words[23,24]. The reversed items for "Physician Centrality" were item 3, "Physicians, as a rule, are team players," and item 4, "The physician should not always have the final word in decisions made by health care teams." The reason for the problem regarding item 3 may be that it was not interpreted as a reversed item. Unlike the other items, item 3 did not contain negative terms such as "not" or "never," but an affirmative answer indicated low levels of physician centrality. Moreover, some participants at the cognitive interview stage said, "I do not understand the meaning of the term 'team player'." "Team player," a term with an English origin, was translated in Japanese to "*chīmupureiy*ā", which is more likely to be interpreted as only a member of a team, not a collaborator. The respondents might find item 4, which included a partially negation expression, confusing.

The four-item version of the Adapted Physician Centrality Scale, for which reversed items had been deleted, had a low Cronbach's alpha coefficient of 0.63. More than 20 to 30 items are needed for a scale to be reliable. The final version of the scale developed in the present study had only four items, which may have decreased its reliability[18]. Additionally, the responses to physician centrality tended vary widely and the respondents therefore preferred the wider range of choices in a previous study[3]. This suggests that the alpha coefficient in this study might also have been low. Moreover, physician centrality measures the attitudes of team members toward physicians' authority and their control over information about patients[3]. The responses among nurses might be inconsistent because physicians have different levels of authority and information management responsibilities in each department. However, a Cronbach's alpha >0.6 for internal consistency is considered acceptable at least[25,26]. When the number of items was reduced to four, the value of the item–rest correlations improved and the reliability of the results increased. Furthermore, the value of the Cronbach's alpha of our scale similar to the 0.68 of the

original scale, although the number of items was decreased from six to four. We therefore believe that changing the Adapted Physician Centrality Scale from six items to four items was reasonable.

Confirmatory factor analysis indicated that the version of the Adapted Physician Centrality Scale consisting of four items with a one-factor structure had better goodness-of-fit indices than did the six-item version. The criteria for the cutoff point of the goodness-of-fit measure for structural equation modeling have changed historically, but the criteria of Hu and Bentler[19] are often cited. With these criteria, the TLI and RMSEA in our analysis were not sufficient. However, Hu and Bentler examined the adequacy of cutoff criteria with different sample sizes, including 150, 250, and 500. They recommended that the TLI and RMSEA should not be used for sample sizes of less than 250[19]. Our sample size was close to 250, so we did not apply the criteria of the TLI and RMSEA. Instead, we evaluated the goodness of fit via SRMR, which is an absolute fit index that is the most sensitive for models with misspecified factor covariance. We also used CFI, which is one of the incremental fit indices recommended for use in combination with SRMR [19,27]. Therefore, by applying a combination of SRMR and CFI, our results suggested that the Adapted Physician Centrality Scale with four items and a one-factor structure had sufficient goodness of fit.

Although the total possible score of 30 points on the original six-item scale is greater than that of the 20 points on the four-item version of the Adapted Physician Centrality Scale, the mean score of our scale in the present study was higher than that of the ATHCTS in the United States. No floor or ceiling effects were observed for the whole scale or for any individual item. In a previous study of the original scale in the United States the mean ± SD score for advanced practice nurses ($n=113$) was 5.7 ± 4.4 (95% CI : 4.88-6.52) and that of registered nurses ($n=173$) was 7.4 ± 4.8 (95% CI : 6.68-8.12)[3]. In contrast, the mean ± SD score of our scale in the present study was much higher (10.3 ± 2.8 ; 95% CI : 9.99-10.61). The Japanese nurses who participated in our study are thought to be equivalent to registered nurses in the United States. Our results suggest that physician centrality is higher for nurses in Japan than for registered nurses in the United States. This finding might be due to Japanese nurses having less autonomy than nurses in the United States[28,29].

Several studies have shown that cooperation and collaboration between nurses and physicians are difficult because the physician-dominated relationship cannot be broken down by either nurses or physicians. In team medical care, physicians are commonly recognized as the most appropriate leaders, and other occupations are less often considered appropriate, which is a challenge for the promotion of team medical care[30,31].

Use of the Adapted Physician Centrality Scale in Japan should help determine whether physician centrality affects both interprofessional collaboration and the autonomy, professional identity, and learning goals of health care professionals.

*Limitations*

The present study had two notable limitations. First, whether the results can be generalized to other settings remains unclear because the nurses were working in a secondary care setting at a teaching hospital in an urban residential area. The results may therefore be limited to the nurses that participated in this study ; to verify our findings, similar surveys at other institutions are needed. A second limitation is that we obtained the results of this study in Japan and decided to adopt a four-item version of our Adapted Physician Centrality Scale. Care should therefore be taken when comparing the findings obtained with our scale and findings obtained with the "Physician Centrality" subscale of the ATHCTS. However, like "Physician Centrality" subscale of the ATHCTS, our scale has a one-factor structure, and the four-item version of our scale demonstrated higher internal consistency and better goodness of fit in confirmatory factor analysis than did the six-item version. In this respect, our scale appears to have acceptable internal consistency and structural validity.

Although the ATHCTS has been used among many types of health care professionals. the present study of the Adapted Physician Centrality Scale included only nurses. Therefore, we plan to examine the overall adaptability of our scale by using it with other health care professionals. Criterion-related validity will be reported in the future. This scale is likely useful for identifying how physician centrality affects interprofessional collaboration and learning about the attitudes among health care professionals.

## Conclusion

The results of the present study suggest that our Adapted Physician Centrality Scale has sufficient internal consistency and structural validity for measuring physician centrality in Japan. Furthermore, the findings suggest that physician centrality is more apparent in Japan than in the United States.

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*Conflict of interest*

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*Authors' contributions*

RH conceived the conceptual design of the study, conducted the analysis, interpreted the data, and drafted the manuscript. RM and MG contributed to the conception of the study and the acquisition of the data. DH, YSu, HI, YSa, SS, KI, and TN contributed to the interpretation of the data and discussions to help draft the manuscript. MM contributed to the conception and design of the study and to the analysis and interpretation of the data. All authors read and approved the final manuscript.

*Availability of data*

No additional data are available.

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