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Characteristics of early-career nurse researchers negatively impacted during the COVID-19 pandemic: a cross-sectional study

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ABSTRACT

Objectives This study aimed to identify typical patterns and determinants of early-career nurse researchers (ECNRs: age ≤45 years) who reported that their research activities were negatively impacted during the COVID-19 pandemic, using a data mining methodology. To gain a deeper understanding of the characteristics of these ECNRs, we compared them with the characteristics of senior nurse researchers (SNRs: age ≥46 years).

Design A cross-sectional study.

Participants 1532 nurse researchers.

Data collection and analysis We conducted an anonymous online questionnaire survey that assessed individual and professional attributes of nurse researchers and their experiences from April to June 2020. We analysed the association between the impact on research activities and the individual and professional attributes using cross-tabulation, and employed the chi-square automatic interaction detection technique to perform population segmentation.

Results We found that difficulties in research management, an increased burden of student education and organisational management, and organisational management position were relatively important factors for determining the negative impact of COVID-19 on the research activities of ECNRs (p<0.05). For both ECNRs and SNRs, the most relevant determinant of disrupted research activities was 'difficulties in research management' (χ^2=34.7 and 126.5, respectively, p<0.001 for both). However, only ECNRs yielded 'position in organisational management' and was extracted only for ECNRs (χ^2=7.0, p=0.008).

Conclusions Difficulties in research management and an increased burden of student education and organisational management had an unfavourable impact on the research activities of ECNRs. To ensure quality of nursing care and nursing science development during and after the COVID-19 era, it is important to support ECNRs in their nursing research activities and career development. Our findings could contribute to the prioritisation of interventions and policymaking for ECNRs who are particularly at risk of being negatively affected by the pandemic.

Strengths and limitations of this study

► This is the first study to identify the typical patterns and determinants of early-career nurse researchers negatively affected during the COVID-19 pandemic.

► A major strength is the use of data mining methodology, which enabled to reveal hierarchies and combinations of factors influencing the research activities.

► A limitation is that the results may not be transferable to all nurse researchers because the study involved members of only one academic society, although it is the largest nursing society in Japan.

INTRODUCTION

As of September 2021, the novel SARS-CoV-2, which is responsible for the COVID-19 pandemic, had cumulatively infected more than 200 million people and caused over 4 million related deaths worldwide.[1]

COVID-19 has caused unprecedented disruptions in scientific research activities and forced changes in and suspension of research protocols because of the emphasis on social distancing efforts, which is the basis of non-pharmaceutical interventions for infection control. It also has a significant impact on the activities of researchers in creating, conducting and publishing research, such as writing papers, obtaining research funding and networking with other researchers.[2 3] Early-career researchers generally need support and mentoring to obtain research funding and form research management teams.[4 5] Researchers in this growth phase have been reported to be particularly affected by critical and rapid changes in the research environment caused by the COVID-19 pandemic.[3]

Nursing research is defined as 'a scientific process that validates and refines existing knowledge and generates new knowledge that directly and indirectly influences the delivery of evidence-based nursing,'[6] and oftentimes, its targets are patients or people in vulnerable situations. As a result, nurse researchers around the world have also been forced to change their research processes, including

study designs, data collection methods and interventions, during the COVID-19 pandemic.[7] Many nurse researchers belong to educational and research facilities, such as universities, to disseminate excellent nursing practice, and they are responsible for the development of nursing science through nursing research. Due to the COVID-19 pandemic, some nurse researchers have had to spend an enormous amount of time switching from face-to-face to online instruction to ensure continuous learning and provide mental support to students, especially those with large workloads.[7 8] In addition, the insufficient number of healthcare professionals who provide care to patients with COVID-19 and help to prevent the spread of the infection in local populations in clinical settings may have caused nurse researchers to focus temporarily on nursing practice, and this may have contributed to stalled research activities.[9] In an online survey on the impact of COVID-19 on nursing research activities conducted in Japan by the ad hoc community of the Japan Academy of Nursing Sciences (JANS), approximately 81.9% of nurses reported that COVID-19 interfered with their research activities.[10 11] JANS is a membership organisation and is the largest nursing society in Japan.

However, to our knowledge, few studies have been conducted on factors related to the COVID-19 pandemic that have hindered the research activities of early-career nurse researchers (ECNRs), or on ECNRs who may be more susceptible to restrictions in their research activities. Identifying the characteristics of ECNRs who are likely to be negatively affected by changes in the research environment during the prolonged COVID-19 pandemic could help senior nurse researchers (SNRs) and institutional administrators in assessing the support needs of ECNRs and developing strategies to promote their career development and research activities. It could also contribute to the consideration of national and international policies that will not interfere with the development of nursing science and research during this era. At the same time, to provide efficient and effective support, it is important to identify and prioritise interventions for ECNRs who are particularly at risk of being negatively affected by the pandemic.

Data mining can help to reveal how the combined patterns of an individual's characteristics are related to the situation of interest. The chi-square automatic interaction detector (CHAID) is one of the most widely used decision tree methods for population segmentation. In this method, the association between the target and explanatory variables is examined using the χ^2 test, and the variables with the highest χ^2 values are used for segmentation.[12] The CHAID dendrogram is a hierarchical tree diagram in which the higher the explanatory variable is in the tree, the more strongly it is associated with the target variable. CHAID has been used in the healthcare field, such as in the development of methods for identifying high-risk individuals in target populations.[13]

Given this background, the purpose of this study was to identify the typical patterns and determinants of ECNRs

whose research activities were negatively impacted during the COVID-19 pandemic (between April and June 2020, the first period of a critical level of COVID-19 spread in Japan), using the CHAID data mining methodology. Furthermore, to gain a deeper understanding of the characteristics of ECNRs, we conducted the same analysis for SNRs and compared the extracted patterns and determinants. The data used for the analysis in this study are all part of the original survey data collected by JANS,[10] which also published the results of descriptive statistics and related papers and approved this study. However, there is no overlap between this study and the JANS surveys.

METHODS

Study design
This cross-sectional study, which adhered to the Strengthening the Reporting of Observational Studies in Epidemiology guidelines,[14] comprises a post-hoc analysis of the online self-administered questionnaire used in the survey conducted by JANS from 1 July to 10 August 2020.[10]

Participants
Participants were the nurse researchers who responded to a survey by JANS. During the survey period, JANS announced this online survey on its website (which was accessible to 9524 JANS members) and sent an email invitation with the survey link to 9447 members who had registered their email addresses with the academy. Of these, 1532 who consented to the survey (response rate: 16.1%) were included in the analysis.

Research design and data collection
A cross-sectional study using the online survey was conducted. A survey announcement was posted to participants on the JANS website, together with explanation of the purpose of the study, privacy protection and the freedom to participate. The participants responded to the questionnaire anonymously and were deemed to have provided consent to participate in the study upon submission of the online survey form.

Study variables
In the survey, the participants were asked about their experiences in the previous 3 months (April–June 2020). The full version of the questionnaire can be found on the JANS website.[10]

The definition of an ECNR varies depending on the culture of the organisation and the context in which the term is used. The Science Council of Japan, one of the special agencies of the Cabinet Office and the largest Japanese national academy, defines young researchers as those aged ≤45 years who need support for research grants, stable posts and international research development. Therefore, in this study, we operationally defined ECNRs as nurse researchers who were aged ≤45 years and SNRs as those aged ≥46 years.

In this study, the target variable was the negatively impacted or not on research activities during the COVID-19 pandemic, as reported by the participants themselves. During the original data collection, the degree to which the participants' research activities were negatively impacted during the COVID-19 pandemic was assessed on a 5-point ordinal scale. For this study, we regrouped these data into two categories: (1) negative impact on research activities ('much more' or 'more' in the original data) and (2) no impact on research activities ('neither/about the same,' 'less' or 'much less' in the original data). This regrouping was performed because the sample sizes were too small at some levels.

The available explanatory variables (dummy variables) were as follows:

▶ Individual and professional attributes: gender (1: female, 0: male), type(s) of the facility in which the participant worked (2: hospitals and long-term care facility, 1: educational and research institution, 0: others), position in organisational management (1: professor/associate professor/lecturer at an educational and research institution, or administrator of a hospital and long-term care facility; 0: others), presence of cohabitants (1: yes, 0: no), involvement in childcare/caregiving (1: yes, 0: no), and place of residence (1: prefectures under specific precautions, 0: other prefectures). In May 2020, the Japanese government designated 13 prefectures (Tokyo, Osaka, Hokkaido, Ibaraki, Saitama, Chiba, Kanagawa, Ishikawa, Gifu, Aichi, Kyoto, Hyogo and Fukuoka) as 'prefectures under specific precautions' that had to make a special effort to prevent the spread of COVID-19.

▶ Factors that may have hindered research activities: based on a literature review and expert findings, JANS investigated 33 factors that may have affected the research activities of nurse researchers. In this study, similar factors were subdivided into the following six categories to ensure a sufficiently large sample size for segmentation. The researchers discussed and categorised factors based on the concept of COVID-19 infection control measures and the associated changes in social conditions, research and other roles in the organisation, and family roles. The six categories were difficulties in in-person contact and transport, difficulties in research management, increased time spent on student education and organisational management activities, information and communication technology (ICT) proficiency needs and support for others, family role burden and conflicts, and changes in social conditions and conflicts related to the COVID-19 pandemic (table 1). The influence of each of these six factors was examined (1: yes, 0: no).

First, we analysed the association between the negative impact on research activities and the individual and professional attributes using cross-tabulation. Then, we performed data mining using CHAID. SPSS software V.27.0 was used for all analyses, and the level of significance was set at 5%.

Patient and public involvement

No patients were involved in this study.

RESULTS
Participant characteristics

Of the 1532 respondents who completed the survey, 1201 were included in the analysis after excluding those with missing data (percentage of valid responses among all responses: 78.4%). Table 2 shows the characteristics of all respondents, and table 3 shows the characteristics of participants analysed in this study. Of the 1201 participants analysed, 332 ECNRs (80.8%) and 667 SNRs (84.4%) reported that their research activities were negatively affected during the COVID-19 pandemic. The percentage of women was 78.0% in the ECNRs and 95.8% in the SNRs. Since most of the missing values were for individual and professional attributes, no missing value completion was performed. No differences in the characteristics of the attributes were found between the total survey respondents and the participants (tables 2 and 3).

An analysis of the association between the negative impact on research activities and the individual and professional attributes revealed significant associations for institutional affiliation in the SNRs and position in organisational management in the ECNRs (table 3, p<0.001 and p=0.008, respectively). Regarding the comparison between the ECNRs and SNRs, ECNRs tended to be more likely to be cohabiting and involved in childcare (table 3). On the other hand, SNRs tended to be more likely to be female, have positions in organisational management and involved in caregiving.

Typical patterns and determinants of researchers negatively affected by COVID-19

The CHAID dendrogram showed five representative patterns for ECNRs whose research activities were negatively affected by COVID-19 and six patterns for SNRs (figure 1). These results indicate that the proportion of those whose research activities were negatively affected increased with the growth of the decision tree consisting of 'yes' determinants, whereas the proportion of those who were not affected increased with the growth of the decision tree consisting of 'no' determinants. Among the explanatory variables, those with a weak relative relevance to the objective variables were not extracted in the CHAID analysis. The distribution of the explanatory variables in each pattern is presented in table 4.

First, in the analysis of ECNRs, among the explanatory variables, the factor that affected the research activities of ECNRs the most was 'difficulties in research management', followed by 'increased time spent on student education and organisational management activities' and 'position in organisational management' (figure 1A; χ^2=34.7–4.4, p<0.05 for all). Regarding the most affected

Table 1 Factors influencing nursing research activities during the COVID-19 pandemic

Influencing factors used as explanatory variables in this study (categories)	Correspondence to JANS original survey items
Difficulties in in-person contact and transport	Difficulty in in-person contact with study participants
	Difficulty in entering research facilities/institutions
	Difficulty in securing means of transport for domestic travel and business trips
	Difficulty in securing means of transport for overseas travel and business trips
Difficulties in research management	Difficulty in accessing equipment, literature, materials, data, computers and software necessary for research
	Difficulty in using research technical assistants (including doctoral research assistants)
	Research efficiency lowered by working from home
	Difficulty in holding meetings with co-researchers inside/outside their affiliated organisation
	Decreased function of departments, organisations and institutions related to research (administration, ethics review boards, organisations participating in the research project, partners in outsourcing for surveys and research)
	Difficulty securing the necessary budget owing to changes to the research plan
	Difficulty of peer support and communication related to research
	Slowdown in joint research with co-researchers
	Slowdown in joint research with graduate students
Increased time spent on student education and organisational management activities	Increase in time for research supervision
	Increased time spent for lectures (including preparation and assessment)
	Increased time spent for seminars (including preparation and assessment)
	Increased time spent for practicum (including preparation and assessment)
	Increased time spent for clinical practice
	Increased time spent on the health management of students and staff (eg, checking health status)
	Increased time spent on supporting students and staff showing fear of infection
	Increased time spent on counselling other students and staff (for employment, mental health, economic support)
	Increased time spent on management/administration (meetings, committee activities, open campus, career workshops)
ICT proficiency needs and support for others	Increased time spent on learning about ICT
	Increased time spent on ICT-related support for managers, colleagues, subordinates and the organisation (eg, installation and support for using online meeting systems)
Family role burden and conflicts	Increased time spent on housework related to COVID-19
	Increased time spent on infection prevention and health management related to the effects of COVID-19 in the family
	Internal and interpersonal conflicts in the family related to COVID-19
	Increased time spent on childcare owing to COVID-19-related closures of daycare centres, kindergartens, schools or restricted attendance of school
	Increased time spent on care of parents or other elderlies related to COVID-19 (closures of day services and short stays)
	Guilt and conflicts in not being able to perform COVID-19 measures adequately for the housework, childcare or care for elderlies/parents (eg, measures to prevent infection in the home)
Changes in social conditions and conflicts related to the COVID-19 pandemic	Delays in the review and publication processes of submitted manuscripts (Japanese/English)
	Guilt and conflicts in not being able to contribute to COVID-19 measures professionally
	Increased time spent on social contributions related to COVID-19 (eg, academic society committee activities, public lectures)

ICT, information and communication technology; JANS, Japan Academy of Nursing Sciences.

Table 2 Characteristics of all respondents (N=1532)

Attributes		Number of respondents	n (%)
Negative impact on research activities		1526	1251 (82.0)
Age	Early-career nurse researchers	1454	499 (34.3)
Gender	Female	1445	1059 (89.2)
Type of facility to which the participant belonged	Educational and research institution	1451	1229 (85.9)
	Hospitals and long-term care facility		145 (10.1)
	Others		57 (4.0)
Position in organisational management		1399	985 (70.4)
Presence of cohabitant		1356	855 (63.1)
Involvement in childcare		1376	476 (34.6)
Involvement in caregiving		1377	396 (16.1)
Living in a prefecture under specific precautions		1436	186 (65.4)

pattern in ECNRs (ECNR pattern 4 in table 4), all had difficulties in research management, spent more time on student education and organisational management activities, and held positions in organisational management.

On the other hand, in the analysis of SNRs, 'difficulties in research management', 'difficulties in in-person contact and transport', 'increased time spent on student education and organisational management activities', and 'family role burden and conflicts' were found to be significant determinants (figure 1B, χ^2=126.5–7.1, p<0.01 for all). Regarding the most affected pattern in SNRs (SNR pattern 3 in table 4), all had difficulties in research management, difficulties in in-person contact and transport for research activities, and household role burdens and conflicts; more had childcare and caregiving roles than any other group.

Comparison between ECNRs and SNRs

For both ECNRs and SNRs, the most relevant determinant of disrupted research activities was 'difficulties in research management' (figure 1).

Regarding the comparison between ECNRs and SNRs, although some common factors disrupted their research activities, the determinant 'position in organisational management' was extracted only for ECNRs. This was not a significant factor for SNRs because most were involved in organisational management. In addition, 'difficulty in face-to-face contact and transportation' and 'family role burden and conflicts' were extracted only for SNRs.

DISCUSSION

To our knowledge, this is the first study to examine how the research activities of ECNRs were affected during the COVID-19 pandemic, to identify typical patterns and determinants of ECNRs who were negatively affected in particular, and to gain a better understanding of the characteristics between ECNRs and SNRs. The analysis revealed that difficulties in research management and an increased burden of student education and organisational management left an unfavourable impact on the research activities of ECNRs (figure 1A).

COVID-19-related factors that negatively affected research activities among ECNRs

Factors identified as impediments to research activities among ECNRs, such as 'difficulties in research management' and 'increased time spent on student education and organisational management activities', were also identified among SNRs (figure 1). Hereafter, we discuss the background of the factors identified among ECNRs.

The most relevant issue that affected the research activities of ECNRs was 'difficulties in research management' (figure 1A). Since the WHO declared the spread of COVID-19 a pandemic in March 2020, there have been calls for the continued implementation of social distancing efforts and travel restrictions around the world. This has reduced the opportunities for laboratory experiments and analyses, informal conversations among researchers, exchange of ideas and the latest findings, and smooth research operations.[15 16] These changes in the research environment may have had a significant impact on knowledge sharing and stimulation of the research mindset and scientific creativity, networking and career development among ECNRs, and they are easily accepted as the most significant related factors. In addition, nurses, the largest occupational group in the health sector worldwide,[17] have also made notable contributions to clinical practice during the pandemic, including evidence-based health education, infection prevention and disease surveillance, and acute care.[18–21] On the other hand, research contributions have been limited, and there have only been a few research grants in the nursing discipline for such enormous and valuable expertise and experience in responding to the COVID-19 pandemic. Financial support is needed to enable nurse researchers, including ECNRs, to generate and disseminate evidence through research.

Table 3 Characteristics of the participants (n=1201)

N (%)

Attributes		ECNRs (n=411)			SNRs (n=790)			Comparison between ECNRs and SNRs*
		Negative impact on research activities (n=332)	No impact on research activities (n=79)	Comparison within ECNRs*	Negative impact on research activities (n=667)	No impact on research activities (n=123)	Comparison within SNRs*	
Gender	Female	259 (78.0)	60 (75.9)	0.764†	639 (95.8)	121 (98.4)	0.207†	<0.001***†
Type of facility in which the participant worked	Educational and research institution	296 (89.2)	65 (82.3)	0.081‡	612 (91.8)	99 (80.5)	<0.001***‡	0.508‡
	Hospitals and long-term care facility	32 (9.6)	14 (17.7)		49 (7.3)	23 (18.7)		
	Others	4 (1.2)	0 (0.0)		6 (0.9)	1 (0.8)		
Position in organisational management		160 (48.2)	25 (31.6)	0.008**†	593 (88.9)	108 (87.8)	0.756†	<0.001***†
Presence of cohabitant		229 (69.0)	57 (72.2)	0.683†	399 (59.8)	72 (58.5)	0.842†	<0.001***†
Involvement in childcare		163 (49.1)	39 (49.4)	1.000†	186 (27.9)	32 (26.0)	0.742†	<0.001***†
Involvement in caregiving		15 (4.5)	5 (6.3)	0.559‡	143 (21.4)	25 (20.3)	0.905†	<0.001***†
Living in a prefecture under specific precautions		226 (68.1)	58 (73.4)	0.417†	426 (63.9)	73 (59.3)	0.361†	0.023*†

*Shown are p values: *p<0.05, **p<0.01, ***p<0.001.
†The X² test.
‡Fisher's exact test.
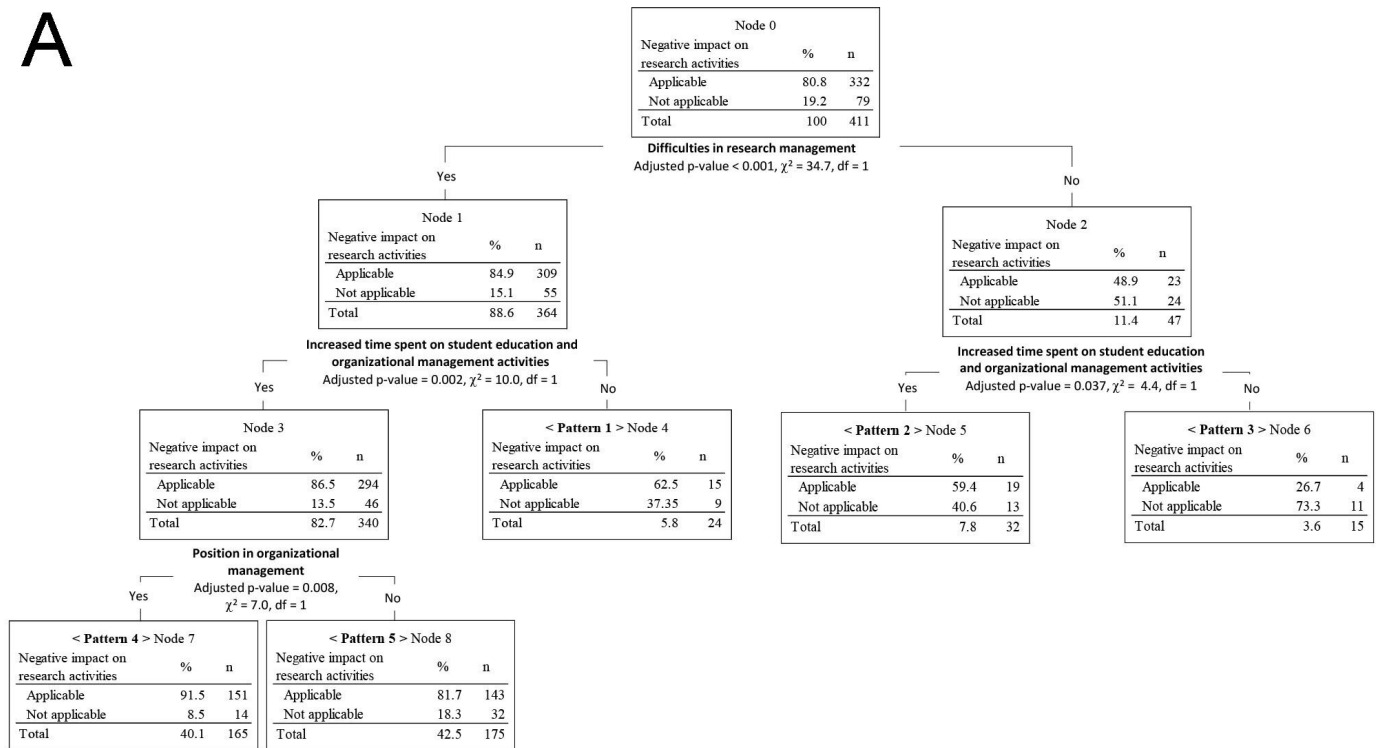ECNRs, early-career nurse researchers; SNRs, senior nurse researchers.

The second strongest factor associated with the negative impact on the research activities of ECNRs was 'increased time spent on student education and organisational management activities' (figure 1A). The period of this study was the first time when Japan experienced a critical level of COVID-19 spread. Nurse researchers were confused by not only the restrictions placed on practical training in hospitals and long-term care facilities but also the need for educational and research institutions to switch to flexible teaching methods that combine face-to-face and online instruction while monitoring the level of infection spread.[22] ECNRs who worked in hospitals and long-term care facilities were on the front line struggling with COVID-19 and striving for individualised, hands-on nursing practice. In addition, especially in Japan, researchers at universities and other educational and research institutions had been devoting substantial efforts to student education even before the pandemic, and this tendency was stronger for younger researchers.[23] This may have led to an increase in the amount of time spent on educating students (changing teaching styles and following up with students who study online) and on student healthcare during the pandemic. Being an ECNR, in particular, may have been extracted as an influencing factor, as student education and practice time accounted for a large percentage of the time spent in educational organisations. It can also be inferred that ECNRs with positions in organisational management were the most affected by research activities, as organisational management was added to the aforementioned roles (figure 1A).

Comparison of factors that disrupted the research activities of SNRs versus ECNRs

As with ECNRs, the most relevant determinant of disrupted research activities among SNRs was 'difficulties in research management' (figure 1B). Since SNRs tend to conduct studies with relatively large teams and research funding, it can be inferred that it was more difficult for them to communicate with collaborators, coordinate with relevant institutions, and secure budgets and assistants to facilitate research during the pandemic.

It is noteworthy that 'family role burden and conflicts' and 'difficulties in in-person contact and transport' were identified as factors that negatively affected research activities only among SNRs (figure 1B). 'Family role burden and conflicts' may be related to gender stereotypes and experiences, and differences in the impact of COVID-19 on childcare and caregiving. Regarding gender, the academic productivity of female early-career and senior researchers in multiple regions has been reported to be affected by increased household roles, childcare and elderly care during the COVID-19 pandemic.[24–26] However, in this study, there was no relationship between gender and the impact on research activities. The small number of men analysed and the possibility that men also took on family roles may have influenced this gap (table 3). In this study, 62% of male respondents and 45% of female respondents were involved in childcare or caregiving for older adults.
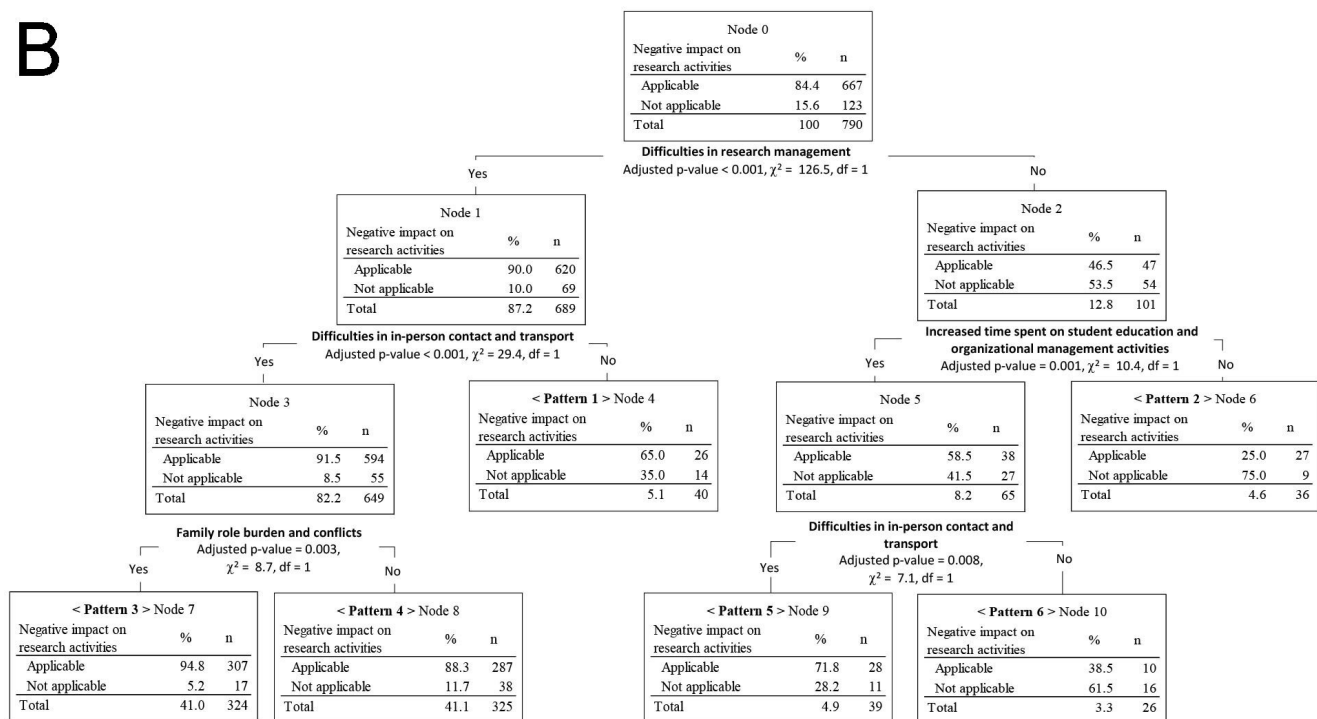
Figure 1 Patterns of factors associated with the negative impact on research activities of nurse researchers. (A) Patterns of early-career nurse researchers. (B) Patterns of senior nurse researchers.

So far, there have been no previous studies on gender characteristics of or gender equality in household roles in the nursing community; thus, future studies and implications for needs-based support strategies are needed. Regarding differences in the impact of COVID-19 on childcare and caregiving, more ECNRs than SNRs took on childrearing roles, but the family role-related factor was not extracted among ECNRs. At the time of the survey, schools were only temporarily closed because of the worsening spread and rising number of new positive cases of COVID-19, and the recent governmental institutional support for research, especially for female researchers

Table 4 Distribution of determinants by pattern

N (%)

Factor		ECNRs					SNRs					
		Pattern 1 (n=24)	Pattern 2 (n=32)	Pattern 3 (n=15)	Pattern 4 (n=165)	Pattern 5 (n=175)	Pattern 1 (n=40)	Pattern 2 (n=36)	Pattern 3 (n=324)	Pattern 4 (n=325)	Pattern 5 (n=39)	Pattern 6 (n=26)
Gender	Female	18 (75.0)	28 (87.5)	9 (60.0)	130 (78.8)	134 (76.6)	39 (97.5)	36 (100.0)	309 (95.4)	313 (96.3)	37 (94.9)	26 (100.0)
Type of facility in which the participant worked	Educational and research institutions	9 (37.5)	32 (100.0)	9 (60.0)	159 (96.4)	152 (86.9)	26 (65.0)	16 (44.4)	307 (94.8)	308 (94.8)	34 (87.2)	24 (92.3)
	Hospitals and long-term care facilities	12 (50.0)	0 (0.0)	6 (40.0)	5 (3.0)	23 (13.1)	12 (30.0)	19 (52.8)	15 (4.6)	16 (4.9)	4 (10.3)	0 (0.0)
	Others	3 (12.5)	0 (0.0)	0 (0.0)	1 (0.6)	0 (0.0)	2 (5.0)	1 (2.8)	2 (0.6)	1 (0.3)	1 (2.6)	2 (7.7)
Position in organisational management		6 (25.0)	12 (37.5)	2 (13.3)	165 (100.0)	0 (0.0)	31 (77.5)	29 (80.6)	280 (86.4)	304 (93.5)	33 (84.6)	14 (53.8)
Presence of cohabitant		19 (79.2)	23 (71.9)	10 (66.7)	113 (68.5)	119 (68.0)	28 (70.0)	23 (63.9)	224 (69.1)	192 (59.1)	18 (46.2)	11 (42.3)
Involvement in childcare		19 (79.2)	22 (68.8)	10 (66.7)	121 (73.3)	114 (65.1)	22 (55.0)	21 (58.3)	224 (69.1)	164 (50.5)	29 (74.4)	5 (19.2)
Involvement in caregiving		10 (41.7)	13 (40.6)	7 (46.7)	99 (60.0)	73 (41.7)	10 (25.0)	6 (16.7)	128 (39.5)	60 (18.5)	9 (23.1)	4 (15.4)
Living in a prefecture under specific precautions		1 (4.2)	0 (0.0)	2 (13.3)	10 (6.1)	7 (4.0)	5 (12.5)	10 (27.8)	97 (29.9)	43 (13.2)	9 (23.1)	0 (0.0)
Difficulties in in-person contact and transport		18 (75.0)	23 (71.9)	5 (33.3)	153 (92.7)	158 (90.3)	0 (0.0)	12 (33.3)	324 (100.0)	325 (100.0)	39 (100.0)	0 (0.0)
Difficulties in research management		24 (100.0)	0 (0.0)	0 (0.0)	165 (100.0)	175 (100.0)	40 (100.0)	0 (0.0)	324 (100.0)	325 (100.0)	0 (0.0)	0 (0.0)
Increased time spent on student education and organisational management activities		0 (0.0)	32 (100.0)	0 (0.0)	165 (100.0)	175 (100.0)	37 (92.5)	0 (0.0)	314 (96.9)	306 (94.2)	39 (100.0)	26 (100.0)
ICT proficiency needs and support for others		6 (25.0)	25 (78.1)	1 (6.7)	129 (78.2)	138 (78.9)	27 (67.5)	3 (8.3)	284 (87.7)	248 (76.3)	24 (61.5)	15 (57.7)
Family role burden and conflicts		11 (45.8)	11 (34.4)	3 (20.0)	122 (73.9)	103 (58.9)	13 (32.5)	1 (2.8)	324 (100.0)	0 (0.0)	15 (38.5)	8 (30.8)
Changes in social conditions and conflicts related to the COVID-19 pandemic		6 (25.0)	10 (31.3)	3 (20.0)	84 (50.9)	98 (56.0)	15 (37.5)	2 (5.6)	191 (59.0)	150 (46.2)	9 (23.1)	6 (23.1)

ECNRs, early-career nurse researchers; ICT, information and communication technology; SNRs, senior nurse researchers.

raising children, may have mitigated the unfavourable impact on ECNRs' research activities. On the other hand, a larger percentage of SNRs than ECNRs played a caregiving role. During the period of serious COVID-19 spread, Japan's long-term care insurance system, which supports people with difficulties in daily living, such as eating, moving and defecating, had to reduce or suspend public long-term care services for a long time to prevent the spread of the infection.[27] The reduced use of services, self-restraint from going out, and lower levels of social interaction worsened the cognitive and physical functions of older adults who required care and thus increased the burden on their caregivers.[27 28] The SNRs analysed in this study included those who were taking on the dual roles of caregiving and childcare, and it is thought that the characteristic determinants of the negative impact on their research activities were extracted as a result of this increased burden of family roles. Regarding 'difficulties in in-person contact and transport', the characteristics of nursing research may have influenced the need to modify research plans, including face-to-face interventions and data collection (figure 1B). Many SNRs are expected to participate in the planning and management of conferences and seminars in Japan and abroad, which may be related to the results.

Implications for the promotion of research activities among ECNRs during and after the COVID-19 era

The WHO states that nursing research must focus on both the quantity of output and the quality of science in order to contribute to the overall knowledge of healthcare professionals.[17] To ensure high-quality nursing and develop nursing science both during and after the COVID-19 era, it will be necessary to support ECNRs in their nursing research activities and career development based on the results of this study.

First, it is necessary to create an environment that is stable enough to prevent the stalling of research activities. Academic societies would require to establish a system that allows ECNRs to receive supervision in research planning and management and to exchange knowledge and networks through virtual meetings (eg, conferences, seminars, journal clubs). Since 2020, JANS has launched some pioneering online projects in Japan, while plans for others are still ongoing. These projects include annual conferences, seminars, journal clubs, virtual meetings and grants for international activities for ECNRs. The administrations of researchers' workplaces also need to consider human and financial support and psychological follow-up in order to help ECNRs maintain both their family and professional roles (eg, job cooperation, support for the use of childcare or caregiving services, mental support for role burden). Particularly in educational and research institutions, it would be useful to strengthen the system for the cross-organisational and integrated implementation of student education. Research grants specific to nursing issues related to COVID-19 (eg, mental health support for nurses, nursing care for vulnerable populations at risk of infection and unfavourable effects such as isolation and depression) are also needed.

Second, nurse researchers must take steps to ensure that their research activities do not stall. With social distancing as a COVID-19 measure and the development of ICT, ECNRs are required to learn and participate in training for effective ICT utilisation to develop and integrate nursing science with informatics. In the nursing field, the construction of systems to fight against COVID-19 over the long term, such as telehealth or telenursing using online monitoring and healthcare delivery systems, and attempts to understand infection trends are already being promoted.[29 30] Besides, nurse researchers should be able to develop their research and handle appropriate research themes and methodologies flexibly in response to major changes in social conditions, such as the case with COVID-19.[31 32] To this end, nurse researchers need to be open to new technologies and innovations and are encouraged to connect globally and with various fields of interest, such as bioethics, sociology, and environmental studies, intentionally and actively.

Finally, the results of this study suggest the importance to consider emotional support, respite, and public financial support for SNRs in their caregiving roles at both institutional and policy levels. As the global population ages, there may be a greater need to support SNRs in their caregiving roles and to identify potential risks to their research activities. Long-term caregiving has a significant impact on the physical, mental and economic well-being of caregivers.[33] SNRs have pioneered and played a pivotal role in the development of nursing science and research and are role models for ECNRs as mentors and researchers. Although the research questions in this study focused on ECNRs, the impact on SNRs will need to be understood in more depth.

Limitations

This study has several limitations. First, the results may not be transferable to all nurse researchers because only 16.1% of members of one academic society responded to the survey, although it is the largest nursing society in Japan. Second, because this study is an analysis of initial impact factors, it is limited in explaining the causal relationship between the prolonged pandemic and ECNRs' research activities, as well as any new disincentives that may have emerged. Further research in other contexts, such as with an increased number of fields or longitudinal surveys conducted, will be necessary in the future.

CONCLUSIONS

The results of this study revealed how the research activities of ECNRs were affected during the COVID-19 pandemic, as well as the typical patterns and determinants of ECNRs whose research activities were negatively affected. The analysis showed that difficulties in research management and an increased burden of student education and organisational management had an unfavourable impact on

the research activities of ECNRs. To ensure the quality of nursing care and the development of nursing science during and after the COVID-19 era, it is important to support ECNRs in their nursing research activities and career development.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not required.

Ethics approval This study involves human participants and was approved by the University of Miyazaki Ethics Committee (approval number: O-0733). The participants responded to the questionnaire anonymously and were deemed to have provided consent to participate in the study upon submission of the online survey form.

Provenance and peer review Not commissioned; externally peer reviewed.

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