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Relationship between COVID-19 care and burnout among postgraduate clinical residents in Japan: a nationwide cross-sectional study

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ABSTRACT

Objective The relationship between the care of patients with COVID-19 and mental health among resident physicians in Japan is imperative for ensuring appropriate care of patients with COVID-19 and should be clarified. We herein assessed the relationship between the care of patients with COVID-19 and mental health among postgraduate year 1 (PGY-1) and PGY-2 resident physicians and factors associated with mental health.

Design This nationwide cross-sectional study analysed data obtained using the clinical training environment self-reported questionnaire.

Setting An observational study across Japan among resident physicians (PGY-1 and PGY-2) from 583 teaching hospitals.

Participants Examinees who took the general medicine in-training examination of academic year 2020.

Primary and secondary outcome measures The Patient Health Questionnaire and Mini-Z 2.0 were used to assess mental health, and experience of caring for patients with COVID-19 was divided into three groups (none, 1–10 and ≥11). The prevalence of mental conditions in the three groups was compared using the 'modified' Poisson generalised estimating equations by adjusting for prefecture-level, hospital-level and resident-level variables.

Results Of the 5976 participants analysed, 50.9% were PGY-1. The prevalence of burnout was 21.4%. Moreover, 47.0% of all resident physicians had no experience in the care of patients with COVID-19. The well-experienced group accounted for only 7.9% of the total participants. A positive association was found between the number of caring patients with COVID-19 and burnout (prevalence ratio 1.25; 95% CI 1.02 to 1.53). Moreover, the shortage of personal protective equipment was identified as a major contributor to burnout (prevalence ratio 1.60; 95% CI 1.36 to 1.88).

Conclusions Resident physicians who experienced more care of patients with COVID-19 had slightly greater burnout prevalence than those who did not. Approximately half of resident physicians did not participate in the care of patients with COVID-19, which posed a challenge from an educational perspective.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study investigated the relationship between the care of patients with COVID-19 and mental health state among postgraduate clinical resident physicians during the COVID-19 pandemic in Japan using nationwide data.
⇒ The resident physicians voluntary participated in this study; however, there was a bias towards the inclusion of highly motivated resident physicians.
⇒ We did not collect information regarding the residents' baseline psychiatric illnesses and personalities, which could have an impact on our study results.
⇒ The number of patients with COVID-19 who experienced care was based on self-reports by resident physicians, which could be inaccurate.

INTRODUCTION

The outbreak of a COVID-19 across China in December 2019 had eventually led to its explosive spread worldwide, prompting the WHO to declare COVID-19 a pandemic by March 2020.[1] This pandemic has substantially increased the demand for medical care, causing detrimental effects, including burnout and depression, on the mental health of healthcare workers, with effects that continue to this day.[2 3] Several reports have indicated that young physicians, such as resident physicians, are more susceptible to mental health problems than older physicians and are considered a high-risk group.[4–6] Hence, residency training organisations are taking steps to protect the mental health of resident physicians from the negative effects of the pandemic.

The COVID-19 pandemic causes psychological stress in resident physicians due to increased workload, trauma, unsafe environment, limited training and limited private

activities.[7–9] In many countries, resident physicians and medical students are involved in the care of patients with COVID-19.[10] Burnout, depression and stress conditions among resident physicians negatively affect not only the resident physicians themselves but also their institutions by increasing work absences and patient safety risk.[6] However, not all physicians are directly involved with the care of patients with COVID-19, with some reports suggesting reduced working hours due to fewer patients with other concerns.[11] Moreover, a significant number of training hospitals may prevent resident physicians from being involved with the care of patients with COVID-19 to hinder the spread of infection among healthcare workers. Identifying the extent of resident physicians' depression and burnout during the current pandemic and examining associated factors will help protect their mental health and promote the development of a sustainable healthcare system. However, despite the growing body of research on the mental health of resident physicians, very little has been conducted in Japan.[12 13] Moreover, available studies have not primarily focused on resident physicians and have been relatively small in size, suggesting the need for high-quality research targeting a larger number of resident physicians.

Therefore, we conducted a survey on the mental health (depression, burnout, stress and job satisfaction) and experiences with the care of patients with COVID-19 among resident physicians in Japan during the COVID-19 pandemic and evaluated the association between resident mental health and COVID-19 practice. We also assess factors associated with mental health among resident physicians in Japan.

METHODS

Study design and population

This nationwide cross-sectional study involved postgraduate year 1 (PGY-1) and PGY-2 resident physicians in Japan. We used the clinical training environment from a self-reported questionnaire to evaluate the relationship between resident physicians' mental health condition and the number of experiencing care for patients with COVID-19. This study followed Strengthening the Reporting of Observational Studies in Epidemiology guidelines.

Under the Japanese medical education system, after graduating from a 6-year medical course and passing the National Examination for Doctors, postgraduates participate in a super-rotation residency programme for 2 years. Resident physicians in Japan are mandated to rotate among seven clinical departments (internal medicine, surgery, emergency medicine, paediatrics, obstetrics and gynaecology, psychiatry, and community-based medicine) and experience general outpatient management at least for 2 years. The Ministry of Health, Laborand Welfare is responsible for establishing clinical training guidelines, regulating clinical training programmes, and setting goals for acquiring communication skill, professionalism and ethics in addition to basic clinical knowledge and skills for resident physicians. A computerised national matching system has been introduced to allow medical students to apply to any clinical training hospitals across Japan. In 2021, 1021 clinical training hospitals have been established. After the 2-year postgraduate super-rotation residency programme, most resident physicians enter specialty-based senior residency training in Japan.

Participants in this study were resident physicians (PGY-1 and PGY-2) who underwent the general medicine in-training examination (GM-ITE) at the end of the 2020 academic year (from 18 to 31 January 2021) in Japan. Immediately after the GM-ITE, participants were asked about their clinical training environment through a self-reported questionnaire, including resident physicians' mental health condition and the number of experiencing care for patients with COVID-19. All participants read the research document explaining data anonymisation, voluntary and the publication of study results prior to participation. Only participants who provided consent to participate were included herein. Participants were also provided the opportunity to opt-out.

Patient and public involvement

This study was not appropriate to involve patients or the public in the design because all participants of this study were resident physicians.

Measurements

We collected data on resident physicians' characteristics (PGY and sex), working environment (number of monthly emergency department (ED) duty, weekly duty hour, number of experiencing care for patients with COVID-19 during their clinical training and personal protective equipment (PPE) supply status) and mental health conditions (burnout, depression, high stress condition and high job satisfaction) through a self-reported questionnaire. Hospital information (type of hospital, category of infectious disease designated medical institution and location) and prefecture information (population and high incidence area of COVID-19) were also determined from the published web page. The endemic areas were 23 of the 47 prefectures, including Saitama, Chiba, Tokyo, Kanagawa, Osaka, Hyogo, Fukuoka and Okinawa.

Mental health conditions (burnout, depression, high stress condition and high job satisfaction) were set as the dependent variable during multivariate analyses. To decrease the burden of the questionnaire immediately after the GM-ITE, we selected a brief scale for assessing these mental health conditions. The Patient Health Questionnaire 2 (PHQ-2) was used to assess depression, whereas the Mini-Z 2.0 was used to assess burnout, high stress condition and high job satisfaction.[14] The PHQ-2 is a screening test for depression and contains two questions that ask respondents whether they had experienced a loss of interest or pleasure and a depressed mood during the past 2 weeks. Responses were collected in a dichotomous 'yes' or 'no' format, with a 'yes' answer to either question

indicating a positive depression screening. A Japanese version of the PHQ-2 is available, the validity of which has been previously evaluated.[15] A meta-analysis reported that the questionnaire has a sensitivity of 76% and a specificity of 87% for diagnosing major depression.[16] The Mini-Z 2.0, which also has a Japanese version, is a 10-item questionnaire that assesses physicians' well-being.[17] The single questions for burnout, stress and satisfaction included in the Mini-Z 2.0 were used in this study. A previous study had shown that a 'single-item measure of burnout' was associated with higher levels of emotional exhaustion (EE).[18] The diagnostic properties of the single-item measure of burnout have been investigated in both the original and Japanese versions.[19 20] The Japanese version has a sensitivity of 54% and a specificity of 88% for the diagnosis of burnout, which were comparable to those of the original version.[20] Each question was rated on a 5-point Likert scale, the scoring for which is described in the online supplemental appendix 1.

In this study, the main independent variable of interest was the number of experiencing care for patients with COVID-19 during clinical training in the current pandemic. The number of experiencing care for patients with COVID-19 was self-reported based on the following five categories: category 1 (0 patient), category 2 (1–10 patients), category 3 (11–20 patients), category 4 (21–30 patients) and category 5 (31 patients or more). During the analysis of the afore-mentioned data, the number of categories was reclassified from 5 to 3 given that the number of responses for categories 4 and 5 was extremely small for any question.

General medicine in-training examination

In the USA, an in-training examination to assess clinical knowledge called the Residency Internal Medicine In-Training Examination (IM-ITE) is administered during training.[21–23] The GM-ITE is an examination administered in Japan using a methodology similar to that for IM-ITE. The purpose of the GM-ITE is to provide resident physicians and training programme directors with an objective, reliable and valid assessment of clinical knowledge. The current GM-ITE consists of 60 questions across four main subjects: medical interview and professionalism, symptomatology and clinical reasoning, physical examination and clinical procedures, and disease knowledge, with some questions presented in video and audio format. The GM-ITE was developed by the JAMEP (Japan Institute for Advancement of Medical Education Program), a non-profit organisation, in 2011 and has been administered continuously every year since then. The questions are developed annually by a committee of experienced physicians and peer reviewed by an independent committee. The GM-ITE can only be taken by resident physicians who belong to training hospitals authorised to administer the GM-ITE.[24–26]

Statistical analyses

The association between the care of patients with COVID-19 and mental health conditions was examined in terms of prevalence ratios (PRs) estimated using clustered log-linear 'modified' Poisson models in which hospital variation was accounted for as clusters in generalised estimating equations, assuming the compound symmetry structure as working correlation matrix. None of experience with the care of patients with COVID-19 was used as the reference for analysis. The models were adjusted for the type of hospital, category of infectious disease designated medical institution, population, high incidence area of COVID-19, sex, grade, ED duty, PPE supply status, duty hour. All analyses were conducted using SAS V.9.4.

RESULTS

A total of 7669 residents from 593 teaching hospitals joined in the 2020 GM-ITE. Among them, 6816 responded to the self-reported questionnaire survey, resulting in a response rate of 88.9%. We excluded resident physicians with any missing data, ultimately including data for 5976 resident physicians from 583 teaching hospitals for analyses. Table 1 summarises the participants' background information. Accordingly, 47.0% of all resident physicians had no experience in the care of patients with COVID-19. Even among the resident physicians in high incidence area of COVID-19, 38.1% of the resident physicians had no experience with the care of patients with COVID-19. The well-experienced group, defined as those who encountering≥11 patients with COVID-19, accounted for only 7.9% of the total participants. Among the resident physicians, 32.0% were female, 49.1% were PGY-2, 83.6% were from community-based hospitals and 33.0% were located in urban areas. A positive association was noted between the number of experiencing care for patients with COVID-19 and urban area, population, high incidence area of COVID-19, male sex, PGY-2, number of monthly ED duty, weekly duty hour and GM-ITE Score.

Among resident physicians, 21.4% (1277/5976) experienced burnout, 29.4% (1758/5976) experienced depression, 39.2% (2342/5976) experienced high stress condition and 62.4% (3731/5976) experienced high job satisfaction. Tables 2–5 detail the relationship between the number of experiencing care for patients with COVID-19 and mental health conditions (burnout, depression, high stress condition and high job satisfaction) using multivariate analysis. As shown in table 2, only a positive association was observed between the number of experiencing care for patients with COVID-19 and burnout (PR 1.25; 95% CI 1.02 to 1.53). A major factor associated with burnout was the shortage of PPE (PR 1.60; 95% CI 1.36 to 1.88) as shown in table 2. Factors associated with burnout, except for the number of patients receiving COVID-19 care and the shortage of PPE, were follows: quartile 2 of population (PR 1.27; 95% CI 1.01 to 1.59), female sex (PR 0.85; 95% CI 0.77 to 0.94), PGY-2 (PR 0.87; 95% CI 0.79 to 0.95) and moderate ED exposure (3–5 per month) (PR 0.70; 95% CI 0.51 to 0.96) (table 2). As shown in table 3, we indicated no relationship between the number of experiencing care for patients with COVID-19 and depression. As shown in

Table 1 Background information categorised according to experience with care of patients with COVID-19

	Experience with care of patients with COVID-19				
	Total (n=5976)	None (n=2807)	Moderated experienced 1–10 (n=2698)	Well experienced ≥11 (n=471)	P value
Prefecture information					
Population, n (%)					<0.001
Quartile 1 (573 441–1 786 170)	1513 (25.3)	1049 (37.4)	394 (14.6)	70 (14.9)	
Quartile 2 (1 815 865–3 700 305)	1401 (23.4)	840 (29.9)	517 (19.2)	44 (9.3)	
Quartile 3 (5 101 556–7 483 128)	1507 (25.2)	544 (19.4)	831 (30.8)	132 (28.0)	
Quartile 4 (8 839 469–13 515 271)	1555 (26.0)	374 (13.3)	956 (35.4)	225 (47.8)	
High incidence area of COVID-19*, n (%)					<0.001
No	1332 (22.3)	1037 (36.9)	265 (9.8)	30 (6.4)	
Yes	4644 (77.7)	1770 (63.1)	2433 (90.2)	441 (93.6)	
Hospital information					
Type of hospital, n (%)					<0.001
Community-based hospital	4996 (83.6)	2323 (82.8)	2284 (84.7)	389 (82.6)	
University branch hospital	306 (5.1)	88 (3.1)	178 (6.6)	40 (8.5)	
University hospital	674 (11.3)	396 (14.1)	236 (8.7)	42 (8.9)	
Category of infectious disease designated medical institution, n (%)					<0.001
Designated medical institution for infectious disease	2487 (41.6)	1339 (47.7)	958 (35.5)	190 (40.3)	
Non-designated medical institution for infectious disease	3489 (58.4)	1468 (52.3)	1740 (64.5)	281 (59.7)	
Location, n (%)					<0.001
Urban area	1971 (33.0)	590 (21.0)	1129 (41.8)	252 (53.5)	
Rural area	4005 (67.0)	2217 (79.0)	1569 (58.2)	219 (46.5)	
Resident information					
Sex, n (%)					<0.001
Male	4064 (68.0)	1797 (64.0)	1915 (71.0)	352 (74.7)	
Female	1912 (32.0)	1010 (36.0)	783 (29.0)	119 (25.3)	
Grade, n (%)					<0.001
PGY-1	3041 (50.9)	1483 (52.8)	1375 (51.0)	183 (38.9)	
PGY-2	2935 (49.1)	1324 (47.2)	1323 (49.0)	288 (61.1)	
Emergency department duty, n (%)					<0.001
0 per month	220 (3.7)	149 (5.3)	65 (2.4)	6 (1.3)	
1–2 per month	909 (15.2)	502 (17.9)	360 (13.3)	47 (10.0)	
3–5 per month	4205 (70.4)	1991 (70.9)	1895 (70.2)	319 (67.7)	
>6 per month	611 (10.2)	147 (5.2)	367 (13.6)	97 (20.6)	
Unknown	31 (0.5)	18 (0.6)	11 (0.4)	2 (0.4)	
PPE supply status, n (%)					0.02
Sufficient supply	5017 (84.0)	2315 (82.5)	2310 (85.6)	392 (83.2)	
Intermediate supply	611 (10.2)	319 (11.4)	245 (9.1)	47 (10.0)	
Insufficient supply	348 (5.8)	173 (6.2)	143 (5.3)	32 (6.8)	
Duty hour, n (%)					<0.001
0–59 hours per week	2517 (42.1)	1351 (48.1)	1027 (38.1)	139 (29.5)	
60–79 hours per week	2264 (37.9)	1002 (35.7)	1069 (39.6)	193 (41.0)	
>80 hours per week	1195 (20.0)	454 (16.2)	602 (22.3)	139 (29.5)	

*High incidence area of COVID-19 was defined as prefectures designated as endemic or non-endemic areas by setting the median of the cumulative number of patients with COVID-19 between 1 April 2020 and 31 January 2021 as the cut-off value.
PGY, postgraduate year; PPE, personal protective equipment.

table 4, we also indicated no relationship between the number of experiencing care for patients with COVID-19 and high stress condition. In addition, we did not find statistically significant association between the number of experiencing care for patients with COVID-19 and high job satisfaction (table 5).

Table 2 Relationship between care of patients with COVID-19 and burnout in resident physicians

	n	Burnout (%)	aPR*	95% CI		P value
				Lower limit	Upper limit	
Prefecture information						
Population						
Quartile 1 (573 441–1 786 170)	1513	303 (20.0)	1 (reference)			
Quartile 2 (1 815 865–3 700 305)	1401	324 (23.1)	1.27	1.01	1.59	0.03
Quartile 3 (5 101 556–7 483 128)	1507	308 (20.4)	1.06	0.82	1.37	0.66
Quartile 4 (8 839 469–13 515 271)	1555	342 (22.0)	1.16	0.90	1.50	0.24
High incidence area of COVID-19†						
No	1332	280 (21.0)	1 (reference)			
Yes	4644	997 (21.5)	0.92	0.73	1.16	0.47
Hospital information						
Type of hospital						
Community-based hospital	4996	1048 (21.0)	1 (reference)			
University branch hospital	306	70 (22.9)	1.04	0.77	1.41	0.78
University hospital	674	159 (23.6)	1.04	0.86	1.26	0.67
Category of infectious disease designated medical institution						
Designated medical institution for infectious disease	2487	545 (21.9)	1 (reference)			
Non-designated medical institution for infectious disease	3489	732 (21.0)	0.95	0.83	1.07	0.38
Resident information						
Sex						
Male	4064	908 (22.3)	1 (reference)			
Female	1912	369 (19.3)	0.85	0.77	0.94	0.001
Grade						
PGY-1	3041	691 (22.7)	1 (reference)			
PGY-2	2935	586 (20.0)	0.87	0.79	0.95	0.002
Emergency department duty						
0 per month	220	58 (26.4)	1 (reference)			
1–2 per month	909	218 (24.0)	0.85	0.60	1.19	0.33
3–5 per month	4205	843 (20.1)	0.70	0.51	0.96	0.02
>6 per month	611	149 (24.4)	0.86	0.61	1.22	0.39
Unknown	31	9 (29.0)	0.97	0.52	1.80	0.91
Care of patients with COVID-19						
No experience with care of patients with COVID-19	759	162 (21.3)	1 (reference)			
Moderate experience with care of patients with COVID-19 (1–10)	4273	894 (20.9)	0.99	0.89	1.11	0.89
Well experience with care of patients with COVID-19 (≥11 patients)	944	221 (23.4)	1.25	1.02	1.53	0.03
PPE supply status						
Sufficient supply	5017	1011 (20.2)	1 (reference)			
Intermediate supply	611	157 (25.7)	1.31	1.15	1.51	<0.001
Insufficient supply	348	109 (31.3)	1.60	1.36	1.88	<0.001
Duty hour						
0–59 hours per week	2517	520 (20.7)	1 (reference)			
60–79 hours per week	2264	471 (20.8)	1.01	0.90	1.12	0.92
>80 hours per week	1195	286 (23.9)	1.11	0.97	1.28	0.14

*Adjusted for all variables listed in the table using the multivariable modified Poisson regression model with cluster-robust variance.
†High incidence area of COVID-19 was defined as prefectures designated as endemic or non-endemic areas by setting the median of the cumulative number of patients with COVID-19 between 1 April 2020 and 31 January 2021 as the cut-off value.
aPR, adjusted prevalence ratio; PGY, postgraduate year; PPE, personal protective equipment.

Table 3 Relationship between care of patients with COVID-19 and depression in resident physicians

	n	Depression (%)	aPR*	95% CI		P value
				Lower limit	Upper limit	
Prefecture information						
Population						
Quartile 1 (573 441–1 786 170)	1513	459 (30.3)	1 (reference)			
Quartile 2 (1 815 865–3 700 305)	1401	449 (32.1)	1.15	0.99	1.32	0.06
Quartile 3 (5 101 556–7 483 128)	1507	423 (28.1)	0.98	0.83	1.17	0.84
Quartile 4 (8 839 469–13 515 271)	1555	427 (27.5)	0.92	0.77	1.10	0.38
High incidence area of COVID-19†						
No	1332	417 (31.3)	1 (reference)			
Yes	4644	1341 (28.9)	0.92	0.80	1.07	0.27
Hospital information						
Type of hospital						
Community-based hospital	4996	1443 (28.9)	1 (reference)			
University branch hospital	306	98 (32.0)	1.17	0.96	1.43	0.11
University hospital	674	217 (32.2)	1.11	0.96	1.25	0.16
Category of infectious disease designated medical institution						
Designated medical institution for infectious disease	2487	740 (29.8)	1 (reference)			
Non-designated medical institution for infectious disease	3489	1018 (29.2)	1.00	0.92	1.10	0.92
Resident information						
Sex						
Male	4064	1167 (28.7)	1 (reference)			
Female	1912	591 (30.9)	1.07	0.99	1.16	0.08
Grade						
PGY-1	3041	951 (31.3)	1 (reference)			
PGY-2	2935	807 (27.5)	0.87	0.80	0.94	<0.001
Emergency department duty						
0 per month	220	77 (35.0)	1 (reference)			
1–2 per month	909	270 (29.7)	0.87	0.69	1.09	0.21
3–5 per month	4205	1209 (28.8)	0.86	0.70	1.04	0.11
>6 per month	611	192 (31.4)	0.96	0.76	1.21	0.72
Unknown	31	10 (32.3)	0.90	0.52	1.55	0.69
Care of patients with COVID-19						
No experience with care of patients with COVID-19	759	234 (30.8)	1 (reference)			
Moderate experience with care of patients with COVID-19 (1–10)	4273	1235 (28.9)	1.00	0.92	1.09	0.96
Well experience with care of patients with COVID-19 (≥11 patients)	944	289 (30.6)	1.11	0.95	1.30	0.20
PPE supply status						
Sufficient supply	5017	1418 (28.3)	1 (reference)			
Intermediate supply	611	206 (33.7)	1.18	1.06	1.31	0.002
Insufficient supply	348	134 (38.5)	1.35	1.18	1.55	<0.001
Duty hour						
0–59 hours per week	2517	734 (29.2)	1 (reference)			
60–79 hours per week	2264	621 (27.4)	0.94	0.85	1.04	0.21
>80 hours per week	1195	403 (33.7)	1.15	1.03	1.29	0.01

*Adjusted for all variables listed in the table using the multivariable modified Poisson regression model with cluster-robust variance.
†High incidence area of COVID-19 was defined as prefectures designated as endemic or non-endemic areas by setting the median of the cumulative number of patients with COVID-19 between 1 April 2020 and 31 January 2021 as the cut-off value.
aPR, adjusted prevalence ratio; PGY, postgraduate year; PPE, personal protective equipment.

Table 4 Relationship between care of patients with COVID-19 and high stress condition in resident physicians

	n	High stress (%)	aPR*	95% CI		P value
				Lower limit	Upper limit	
Prefecture information						
Population						
Quartile 1 (573 441–1 786 170)	1513	609 (40.3)	1 (reference)			
Quartile 2 (1 815 865–3 700 305)	1401	557 (39.8)	1.00	0.88	1.14	0.97
Quartile 3 (5 101 556–7 483 128)	1507	596 (39.6)	0.97	0.85	1.11	0.67
Quartile 4 (8 839 469–13 515 271)	1555	580 (37.3)	0.89	0.77	1.02	0.08
High incidence area of COVID-19†						
No	1332	522 (39.2)	1 (reference)			
Yes	4644	1820 (39.2)	1.03	0.91	1.18	0.62
Hospital information						
Type of hospital						
Community-based hospital	4996	1909 (38.2)	1 (reference)			
University branch hospital	306	130 (42.5)	1.18	0.99	1.42	0.06
University hospital	674	303 (45.0)	1.21	1.09	1.33	<0.001
Category of infectious disease designated medical institution						
Designated medical institution for infectious disease	2487	988 (39.7)	1 (reference)			
Non-designated medical institution for infectious disease	3489	1354 (38.8)	0.99	0.92	1.07	0.81
Resident information						
Sex						
Male	4064	1548 (38.1)	1 (reference)			
Female	1912	794 (41.5)	1.09	1.02	1.17	0.011
Grade						
PGY-1	3041	1246 (41.0)	1 (reference)			
PGY-2	2935	1096 (37.3)	0.90	0.84	0.96	0.001
Emergency department duty						
0 per month	220	95 (43.2)	1 (reference)			
1–2 per month	909	364 (40.0)	0.94	0.78	1.13	0.50
3–5 per month	4205	1597 (38.0)	0.91	0.77	1.09	0.31
>6 per month	611	270 (44.2)	1.04	0.85	1.28	0.69
Unknown	31	16 (51.6)	1.12	0.79	1.57	0.52
Care of patients with COVID-19						
No experience with care of patients with COVID-19	759	308 (40.6)	1 (reference)			
Moderate experience with care of patients with COVID-19 (1–10)	4273	1641 (38.4)	0.98	0.92	1.05	0.64
Well experience with care of patients with COVID-19 (≥11 patients)	944	393 (41.6)	1.00	0.87	1.14	0.94
PPE supply status						
Sufficient supply	5017	1900 (37.9)	1 (reference)			
Intermediate supply	611	270 (44.2)	1.15	1.06	1.25	<0.001
Insufficient supply	348	172 (49.4)	1.27	1.13	1.43	<0.001
Duty hour						
0–59 hours per week	2517	881 (35.0)	1 (reference)			
60–79 hours per week	2264	913 (40.3)	1.15	1.07	1.24	<0.001
>80 hours per week	1195	548 (45.9)	1.29	1.18	1.42	<0.001

*Adjusted for all variables listed in the table using the multivariable modified Poisson regression model with cluster-robust variance.
†High incidence area of COVID-19 was defined as prefectures designated as endemic or non-endemic areas by setting the median of the cumulative number of patients with COVID-19 between 1 April 2020 and 31 January 2021 as the cut-off value.
aPR, adjusted prevalence ratio; PGY, postgraduate year; PPE, personal protective equipment.

Table 5 Relationship between COVID-19 management and high job satisfaction in resident physicians

	n	High job satisfaction (%)	aPR*	95% CI		P value
				Lower limit	Upper limit	
Prefecture information						
Population						
Quartile 1 (573 441–1 786 170)	1513	935 (61.8)	1 (reference)			
Quartile 2 (1 815 865–3 700 305)	1401	865 (61.7)	1.07	0.99	1.15	0.08
Quartile 3 (5 101 556–7 483 128)	1507	951 (63.1)	1.10	1.01	1.20	0.01
Quartile 4 (8 839 469–13 515 271)	1555	980 (63.0)	1.11	1.01	1.21	0.01
High incidence area of COVID-19†						
No	1332	859 (64.5)	1 (reference)			
Yes	4644	2872 (61.8)	0.88	0.81	0.95	<0.001
Hospital information						
Type of hospital						
Community-based hospital	4996	3181 (63.7)	1 (reference)			
University branch hospital	306	173 (56.5)	0.91	0.79	1.05	0.19
University hospital	674	377 (55.9)	0.91	0.83	1.01	0.05
Category of infectious disease designated medical institution						
Designated medical institution for infectious disease	2487	1559 (62.7)	1 (reference)			
Non-designated medical institution for infectious disease	3489	2172 (62.3)	1.01	0.96	1.06	0.74
Resident information						
Sex						
Male	4064	2538 (62.5)	1 (reference)			
Female	1912	1193 (62.4)	1.01	0.97	1.06	0.62
Grade						
PGY-1	3041	1806 (59.4)	1 (reference)			
PGY-2	2935	1925 (65.6)	1.11	1.07	1.15	<0.001
Emergency department duty						
0 per month	220	132 (60.0)	1 (reference)			
1–2 per month	909	524 (57.7)	0.93	0.80	1.08	0.33
3–5 per month	4205	2679 (63.7)	0.99	0.86	1.14	0.89
>6 per month	611	384 (62.9)	0.95	0.81	1.11	0.52
Unknown	31	12 (38.7)	0.65	0.41	1.01	0.05
Care of patients with COVID-19						
No experience with care of patients with COVID-19	759	472 (62.2)	1 (reference)			
Moderate experience with care of patients with COVID-19 (1–10)	4273	2677 (62.7)	1.01	0.97	1.07	0.56
Well experience with care of patients with COVID-19 (≥11 patients)	944	582 (61.7)	1.08	0.99	1.16	0.05
PPE supply status						
Sufficient supply	5017	3209 (64.0)	1 (reference)			
Intermediate supply	611	341 (55.8)	0.87	0.81	0.94	<0.001
Insufficient supply	348	181 (52.0)	0.80	0.72	0.90	<0.001
Duty hour						
0–59 hours per week	2517	1539 (61.1)	1 (reference)			
60–79 hours per week	2264	1437 (63.5)	1.03	0.98	1.08	0.22
>80 hours per week	1195	755 (63.2)	1.02	0.96	1.08	0.48

*Adjusted for all variables listed in the table using the multivariable modified Poisson regression model with cluster-robust variance.
†High incidence area of COVID-19 was defined as prefectures designated as endemic or non-endemic areas by setting the median of the cumulative number of patients with COVID-19 between 1 April 2020 and 31 January 2021 as the cut-off value.
aPR, adjusted prevalence ratio; PGY, postgraduate year; PPE, personal protective equipment.

In online supplemental table 1, we showed the relationship between the number of experiencing care for patients with COVID-19 and the GM-ITE Score. A higher total GM-ITE Score was associated with well-experienced with the care of patients with COVID-19.

DISCUSSION

The current study has been the first to investigate the relationship between the care of patients with COVID-19 and mental health conditions among postgraduate clinical resident physicians during the COVID-19 pandemic in Japan using nationwide data. Accordingly, our results showed that approximately half of resident physicians never experience the care of patients with COVID-19 in Japan and that burnout among resident physicians slightly worsened as the number of experiencing care for patients with COVID-19 increased. Moreover, a significant increase in depression, burnout and high stress condition among resident physicians was observed when the supply of PPE was inadequate.

A number of systematic reviews have shown that the mental health of physicians and resident physicians worsened during the COVID-19 pandemic.[27 28] An umbrella review showed that 40.3% of physicians experienced depression during the pandemic, whereas 17%–19.8% experienced anxiety.[3] Several studies on resident mental health in Japan, most of which were conducted before the COVID-19 pandemic, have reported a 17%–33% prevalence of resident physicians' burnout[29 30] and a 23%–29% prevalence of depression.[31 32] However, only one study on satisfaction with residency training reported high satisfaction (58%),[33] while no study has examined work-related stress during the COVID-19 pandemic. Therefore, the pre-COVID-19 pandemic mental status indicated by the results of these studies is not clearly different from the mental status of the residents in this study who were trained during the COVID-19 pandemic in Japan. Moreover, our findings showed that burnout only slightly increased in resident physicians who cared a high number of patients with COVID-19. This study was conducted in January 2021, during the 'third wave' of the pandemic in Japan and not when the pandemic was at its nadir.[34] It is possible that even during the peak period, several resident physicians did not experience increased workloads and were in a safe work environment, resulting in limited impact on their mental health.

In this study, care of patients with COVID-19 had a positive association with burnout but not with depression, stress or low job satisfaction in residents who cared for many patients with COVID-19. In particular, the discrepancy between burnout and depression results may be due to differences in their concepts. Burnout is a disorder that results from the effects of long-term occupational stress with a corresponding lack of resources.[6] Therefore, it is quite possible that the risk of burnout increases if the patients with COVID-19 care results in heavy workloads. On the other hand, depression is a mental disorder that is composed of multiple factors, including mental, emotional, social and genetic.[35] Furthermore, burnout depends on the inability to cope with stress and it plays a central role in its aetiology, but depression is not necessarily caused by a single stress alone, such as overwork.[36] Thus, in the present study, mental health of Japanese resident physicians showed an association with burnout caused bywork environment burden from COVID-19 patient care, but not depression, which is a psychiatric disease.

Stepwise strategies to ensure that residents receive effective training depending on epidemic situation are needed. In response to the COVID-19 pandemic, numerous resident physicians worldwide restricted their rotations, resulting in the loss of essential learning opportunities. For instance, surgical residents focused on treating patients with COVID-19 instead of surgical training.[37 38] In addition, many studies had reported that several resident physicians and medical students participated in COVID-19 examinations by changing their original curriculum and graduating early.[39 40] In fact, a number of countries had adopted the strategy of including even medical students into the clinical team to support and maintain the health workforce capacity.[10] However, approximately half of the resident physicians included herein reported having never experienced the care of patients with COVID-19, although this study was conducted during 'third wave' of the pandemic in Japan. These results implied that resident physicians were in hospitals across Japan were subjected to human flow control. In fact, keeping health workers on standby was one approach to limit their exposure and prevent nosocomial infections.[41] Moreover, adequate human resource within hospitals is important for managing hospital care during the pandemic. In Japan, the number of doctors per population was lower than that in other developed countries,[42] with resident physicians potentially being an important human resource. Therefore, to manage the pandemic with an 'all hands on deck' approach, introduction of strategies, such as guidelines for redeployment of postgraduate trainees beyond their primary specialties in the USA, need to be considered.[43]

Anxiety regarding inadequate PPE has been reported to contribute significantly to resident physicians' stress.[44] The shortage of adequate PPE for front-line healthcare workers, including respirators, gloves, face shields, gowns and hand sanitiser, had a negative effect on health.[45] The high infection and mortality rates experienced by healthcare workers had been partly due to the inadequate PPE, which acts as a source of stress for resident physicians. In situations where PPE is in short supply, resident physicians may be forced to prepare PPE at their own expense, leading to increased stress and adverse mental health outcomes.[46 47] Furthermore, inadequate education on how to properly wear PPE can be a stressor for residents.[48] The stressors associated with the COVID-19 crisis can also negatively influence residents' ability to learn.[44] Residency programmes should therefore consider the stress

experienced by resident physicians, the negative impact this has on their education, and steps to mitigate it.

The current study revealed the current status and challenges of resident physicians' education during the COVID-19 pandemic in Japan. First, our findings showed that burnout among residents slightly worsened as the number of experiencing care for patients with COVID-19 increased. A related factor that was particularly striking was the shortage of PPE, which may help resident physicians safely participate in the care of patients with COVID-19 by reducing their fear of contracting the virus. Second, we found that only half of resident physicians in Japan were involved in the care of patients with COVID-19. This could have been attributed to the exclusion of resident physicians from front-line care in many hospitals perhaps due to the low level of clinical readiness of Japanese resident physicians.[49] Despite the shortage of medical personnel during the pandemic, medical institutions may have weighed infection control concerns against the usefulness of their workforce and opted for safety. Third, the lack of resident physicians' participation in the care of patients with COVID-19 may have negatively impacted education of resident physicians. Indeed, the current study showed that those with less experience in the care of patients with COVID-19 had lower scores on the in-training examination (online supplemental table 1). Given the expected long-term impact of the pandemic, it is important that resident physicians participate in the care of patients with COVID-19 and receive training. It would be desirable for all resident physicians in Japan to be more actively trained in COVID-19 while considering both mental health and infection control.

Burnout consists of a condition of physical, mental and EE. In general, female physicians tend to experience higher levels of burnout than male physicians.[50–52] It is difficult for female physicians to balance personal life, such as childbirth and childcare, and professional career. Female physicians experience difficulties to be successful in both personal and professional lives. As a result, female physicians may have higher levels of EE than male physicians.[53] On the other hand, our study results showed a higher prevalence of burnout among male physicians than among female physicians. We speculated that the extraordinary circumstance of the COVID-19 pandemic modified study's results.

Our results showed that PGY-1 resident physicians had a higher prevalence of burnout and depression than PGY-2 resident physicians. PGY-1 resident physicians may have a higher stress level than PGY-2 resident physicians generally. The PGY-1 resident physicians have less medical knowledge and skills and clinical experience than PGY-2 resident physicians.[54] In addition, PGY-1 resident physicians are more likely to feel stressed in terms of their responsibility for patients' management. Previous studies have shown ta higher risk of burnout related to both role ambiguity and low levels of decision latitude.[55 56]

As shown in table 2, we have found that resident physicians with a moderate number of ED duties (3–5 per month) had the lowest prevalence of burnout. This result suggested an optimal workload for protecting the mental health among resident physicians. We previously have analysed the relationship between basic clinical competency and the number of ED duties in 11 244 Japanese resident physicians. A moderate number of ED duties (3–5 per month) was most strongly associated with basic clinical knowledge.[24] We believe that there is an optimal workload for both mental health and improvement of clinical competency.

The current study has several limitations. First, this study used simple instruments to determine mental health. Given that this questionnaire was provided to the resident physicians immediately after the GM-ITE, we reduced the number of questions to account for their burden. While the PHQ-2 used to measure depression is highly sensitive and specific for diagnosing depression, this tool has only been used to screen for depression.[16] Only one question was used to determine burnout in the Mini-Z 2.0 survey. Although this one question instrument has a high specificity for diagnosing burnout, it has a rather low sensitivity, which may underestimate the number of those residents experiencing burnout in this study.[19 20] Second, we did not collect information regarding the resident physicians' baseline psychiatric illnesses and personalities. It is possible that resident physicians with depression or anxiety may avoid training hospitals located in COVID-19 endemic areas. Third, the number of experiencing care for patients with COVID-19 was based on self-reports by the residents, which may be inaccurate. In addition, given that only the number of cases cared was asked, we could not determine whether the period of responsibility was partial or total or whether only observation was performed. Fourth, the current study only selected participants from GM-ITE, a voluntary programme, which may have introduced selection bias. The participants of this study accounted for approximately one-third of all resident physicians in Japan, and the training hospitals participating in this study are those more committed to education. Fifth, this study was an observational study involving resident physicians (PGY-1 and PGY-2) from 583 teaching hospitals across Japan. Based on the experiences of patients receiving COVID-19 care, research studies including senior doctors (classified as PGY-3 or above) could have higher clinical and social implications. Sixth, one limitation could not be evaluated using our questionnaire survey for resident physicians. It was impossible to distinguish whether the resident physicians actively examined the patients with COVID-19 or was forced to examine them. If only resident physicians who were forced to examine patients with COVID-19 were included in the analysis, the results of the analysis might have been different. The PR of burnout could have been higher than 1.25. Seventh, the results of our multivariate analyses showed that relatively sparsely populated areas (quartile 2) were significantly associated with burnout and depression as shown in tables 2 and 3. We believe that the factor of social support could be hidden behind

these results. Although we did not evaluate the relationship between the support system and mental health state in the present study, we believe that social support was related to burnout and depression in resident physicians. An abundant support system helps resident physicians to protect their mental health, and a lower level of social support is significantly associated with burnout.[57] Moreover, a previous study had reported that physicians from relatively sparsely populated areas, such as small cities, had less social support from supervisors, family and friends than those from a large city, town and village.[58]

CONCLUSIONS

The current study found that prevalence of burnout slightly increased in resident physicians who cared a high number of patients with COVID-19. Approximately half of the resident physicians in Japan did not participate in the care of patients with COVID-19, which posed a challenge from an educational perspective. Facilitating training in the care of patients with COVID-19 is important for the establishment of a sustainable medical system during the pandemic.

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