



Scale Development for “Great Research Mentors” and Its Relationship to Mentees’ Psychological Burnout in Young Physician Researchers

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Fostering the research skills of young physician scientists is essential to increase the level of medical research in Japan. We aimed to clarify the mentor characteristics associated with a decreased risk of mentees’ psychological burnout. A task team comprising medical doctors, researchers, nurses, and other healthcare professionals developed 35 items related to the characteristics of research mentors. In 2015, we recruited 258 physician researchers who were awarded a new Grant-in-Aid for Young Scientists between 2014-2015 and asked them to score 35 items on a five-point Likert scale. We developed a large research mentor scale using factor analysis and investigated which characteristics (i.e., domains) of the developed scale would be associated with a decreased level of psychological burnout measured by the Copenhagen Burnout Inventory. Maximum likelihood factor analysis with varimax rotation found three domains with 16 items. The three domains were labeled “Building a good trust relationship” (6 items, Cronbach’s alpha = 0.889), “Mentorship in research” (6 items, alpha = 0.853), and “Established and authorized mentor” (3 items, alpha = 0.882). Multivariate linear regression models demonstrated that “Mentorship in research” was inversely associated with personal burnout (PBO) (beta = -6.25, $p = 0.014$) and work-related burnout (WBO) (beta = -4.76, $p = 0.029$); and “Building a good trust relationship” was inversely associated with client-related burnout (CBO) (beta = -4.91, $p = 0.014$). A great research mentor may be encouraged to have mentorship in research and a trusting relationship with mentees for mental health support.

Keywords: burnout; medical education; mentor; professional; psychological

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Introduction

The clinical situation has recently become quite complicated, and numerous new techniques are being developed worldwide. Physicians must be involved in research activities to enhance and keep up with rapid medical evolution. Furthermore, clinical research directly increases patient care quality through unique and innovative research questions embedded in daily clinical practice (Farrugia et al. 2010). Although physician scientists are encouraged to conduct clinical research in Japan, unfortunately, the number of new physicians engaged in research activities has gradually decreased (Fukuhara 2006; Ministry of Education, Culture, Sports, Science and Technology 2022). This

decline in research activity is probably due to the absolute shortage of doctors in Japan (Ishikawa et al. 2013). In 2020, Japan had 2.7 medical doctors per 1,000 persons, whereas the average number among OECD (Organisation for Economic Cooperation and Development) countries was 3.6 in 2019 (OECD 2021; Statistics Bureau, Ministry of Internal Affairs and Communications Japan 2023). Physician shortages further cause overwork, which results in burnout among physicians and may result in serious health consequences for patient care, professionalism, labor safety of physicians themselves, and the sustainability of health systems (West et al. 2018).

A sufficient number of people engaging in research activities is necessary to progress in medical science; none-

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theless, increasing the number of physician researchers in a short period is not practical given the prolonged severe shortage of physicians in Japan (Kobayashi and Takaki 1992; Nomura 2011). Thus, using current human resources effectively and facilitating advancements in physicians' careers and research skills are crucial. We believe that the presence of a mentor for a young physician scientist plays a pivotal role in developing the careers and skills of physician researchers. Indeed, it has been shown that the presence of a research mentor helps young physician researchers publish scientific papers successfully (Takenoshita et al. 2016). Additionally, working environment and conditions appear to be associated with a decreased risk of burnout among physicians (Taka et al. 2016; Perumalswami et al. 2020; Toyoshima et al. 2020).

To date, little is known about the characteristics of research mentors or how these characteristics influence mentees' psychological burnout. Additionally, no scale has been devised to describe the characteristics of research mentors. Such a scale will enhance further investigations on better mentor-mentee relationships to reduce psychological burnout in physician researchers. Therefore, we aimed to 1) clarify the characteristics of an ideal research mentor by developing a scale to measure research mentors' characteristics and 2) test their associations with mentees' psychological burnout in young physician researchers who were awarded the prestigious research grant using the scale. We hypothesized that, in addition to research mentorship, a good relationship between mentees and mentors may be associated with lower levels of psychological burnout among young physician researchers.

Materials and Methods

Study design and participants

This is a cross-sectional study. We identified eligible young physician researchers awarded the prestigious research grant using the Grants-in-Aid for Scientific Research (KAKEN) Database (Japan Society for the Promotion of Science 2022). Participants were required to meet the following inclusion criteria to be eligible for this study: less than 40 years old; received a Grant-in-Aid for Young Scientists S, A, and B in 2014 or 2015; and had medical doctor licenses. We excluded participants who could not be reached because we could not obtain their contact information, had gone to study abroad, or had declined the grant for any reason. In December 2015, we contacted eligible young physician researchers to recruit them and obtain their informed consent.

This study was funded by the Ministry of Education, Culture, Sports, Science and Technology of Japan (Grant in Scientific Research C, Number 25460814). The ethics committee of Teikyo University School of Medicine, Tokyo, Japan approved this study (TU-COI 15-083).

Operational definition of a research mentor

In this study, we defined a research mentor as someone

who is more experienced or knowledgeable in leading or guiding mentees in a specific research area of expertise. If the participants had two or more mentors, they were asked to identify the primary research mentor at the time of this study.

Items related to research mentors' characteristics

We generated 35 items related to research mentors' characteristics through careful discussion with medical doctors, researchers, nurses, and other medical professionals, based on their experience and findings from previously published papers (Sambunjak et al. 2010; DeCastro et al. 2014). All generated items are described in Supplementary Table S1. Participants scored all items ranging from 1 (not at all) to 5 (very much). In addition to the 35 items, we added four questions asking about the negative characteristics of mentors to identify someone who scored the same on all questions without careful consideration. Fortunately, there were no such participants in this study.

Copenhagen Burnout Inventory

The Copenhagen Burnout Inventory is a well-known, publicly available, and previously validated inventory that examines exhaustion and attributes it to three distinctive facets: personal burnout (PBO), which refers to general psychological and physical fatigue burnout; work-related burnout (WBO); and client-related burnout (CBO) (Kristensen et al. 2005). "Client" is replaced by "patient" in this study. Nineteen items were answered using a five-point Likert scale ranging from 100 points for "Always or to a very high degree" to 0 points for "Never/almost never or To a very low degree." If fewer than three questions were answered on the PBO and CBO subscales or fewer than four questions on the WBO subscale, the respondent was classified as a non-responder. The three burnout subscale scores are the average scores of the items in each subscale. Higher scores indicate a greater degree of burnout.

Other mentee characteristics

We obtained participants' demographics, working conditions, training-related information, research type, presence of a research mentor, and research mentors' characteristics. Participants' demographics included sex, age, and marital status. Working conditions included clinical department (basic/social science, surgery, or internal medicine), workplace (teaching hospital, non-teaching hospital, or others), and weekly working hours, excluding research hours. Training-related information included years of physician experience, being a Doctor of Medical Science (DMSc), board certification, and fellowship completion. The research types included basic science, clinical research, and social sciences. In addition, participants were asked about their satisfaction with their mentors using a 5-point Likert scale ranging from 1 (not at all) to 5 (very much). The raw score was converted into a binary index: 0-3, not satisfied, and 4-5, satisfied.

Mentor characteristics

We collected mentors' sex and affiliation (chief of the mentee's department, another researcher from the mentee's department, or a researcher from the mentee's department) as mentors' demographics. Moreover, we asked the following four questions regarding the mentors' characteristics: how the participants found their mentor (by a mentee, by department, or others); which one of the mentees or their mentors usually made the first contact when they needed to talk to (by the mentees, by mentees or mentors, or by the mentor); the frequency of face-to-face meetings with a mentor (every day or 4-5 times/week, 1-3 times/week, 1 time/2 weeks-1 month, or less than one time/2 months); and the mentor-mentee relationship (paternalistic, intermediate, or equal).

Statistical analysis

To develop the Great Research Mentors for Young Physician Researchers scale, we conducted an exploratory factor analysis using the unweighted least-squares method to determine the factor structure of the 35 items regarding research mentors' characteristics. We used the Kaiser-Meyer-Olkin (KMO) index to confirm that the sample was adequate for factor analysis (Beavers et al. 2013). KMO is interpreted as follows: 0.00 to 0.49: unacceptable; 0.50 to 0.59: miserable; 0.60 to 0.69: mediocre; 0.70 to 0.79: middling; 0.80 to 0.89: meritorious; 0.90 to 1.00: marvelous. A scree plot was used to determine the number of factors (eigenvalues > 1) required to construct the scale. Among the 35 items, we excluded items that had a factor loading of less than 0.6 with any factor, or had the same factor loading for two or more factors.

The correlation coefficients between the factors identified in the factor analysis were obtained as indicators of the content validity of the scale. We calculated the Cronbach's alpha index to confirm the internal consistency of each factor. Logistic regression analysis was used to investigate the association of the scale with mentees' satisfaction with their mentors, adjusting for mentees' age and sex to test the convergent validity of the scale.

We compared the characteristics of mentees and mentors between males and females. This was done by assessing participants with scores above the median for the factors identified in the factor analysis and those with median or lower scores. We used the Student's t-test when the F-test indicated homogeneity of variance and the Welch's t-test when the F-test did not support homogeneity of variance for continuous variables. We used the Chi-square test or Fisher's exact test as an alternative to the Chi-square test when one or more cell counts were less than five for nominal variables.

Univariate regression models investigated the associations of the scores of the Great Research Mentors for Young Physician Researchers scale, mentees' characteristics, and mentors' characteristics with psychological burnout. In the models, PBO, WBO, or CBO of the Copenhagen Burnout

Inventory were used as response variables. We then used multivariate linear regression models with psychological burnout as a response variable, factors of the Great Research Mentors for Young Physician Researchers scale ($p < 0.1$ in univariable models) as independent variables, and variables with $p < 0.1$ in univariable models, age, and sex as covariates.

All analyses were conducted using SAS software (version 9.4; Cary, NC, USA). Two-sided statistical significance was set at $p < 0.05$.

Results

We identified 3,143 people who received a new Grant-in-Aid for Young Scientists S, A, and B in 2014 and 2015. We excluded 1,353 participants without medical doctor licenses and identified 1,790 eligible young physician researchers. Fifty-one participants were excluded for the following reasons: we could not find contact information, they had gone to study abroad, or had declined a grant. Therefore, the number of our target young physician researchers was 1,739. Of these, 490 (28.2%) returned the self-administered questionnaires. We excluded 82 participants who did not answer whether they held a medical doctor's license, as well as those who were not engaged in a clinical practice. We excluded 150 participants who did not have mentors. Finally, we analyzed 258 of the 490 young physicians who had mentors. Fig. 1 presents a flowchart of the study.

Characteristics of the participants

Table 1 presents the characteristics of the participants and the group differences between males and females. In total, 74.0% of respondents were male. The mean (SD) age was 36.4 (2.8) years for males and 36.5 (2.6) years for females. The proportion of unmarried participants was significantly lower among males than among females (12.0% vs. 28.4%, $p = 0.002$). Regardless of sex, most participants worked at teaching hospitals. Among the participants, male physicians were more likely to focus on basic research and social medicine than were female physicians (57.6% vs. 48.5% and 6.8% vs. 3.0%). In contrast, female physicians were more likely to focus on clinical science than were male physicians (45.5% vs. 34.6%). Male physicians worked significantly longer each week than their female counterparts (62.6 hours per week vs. 50.6 hours per week, $p < 0.0001$). There was no significant difference in department, percentage of DMSc holders, percentage of board certification holders, and satisfaction with mentors between the sexes. Moreover, the burnout inventory scores did not differ significantly between males and females (PBO, $p = 0.466$; WBO, $p = 0.321$; and CBO, $p = 0.118$).

Mentor characteristics

The mentors' characteristics are listed in Table 1. Regardless of the mentees' sex, most mentors were male; however, female mentees were more likely to have a female

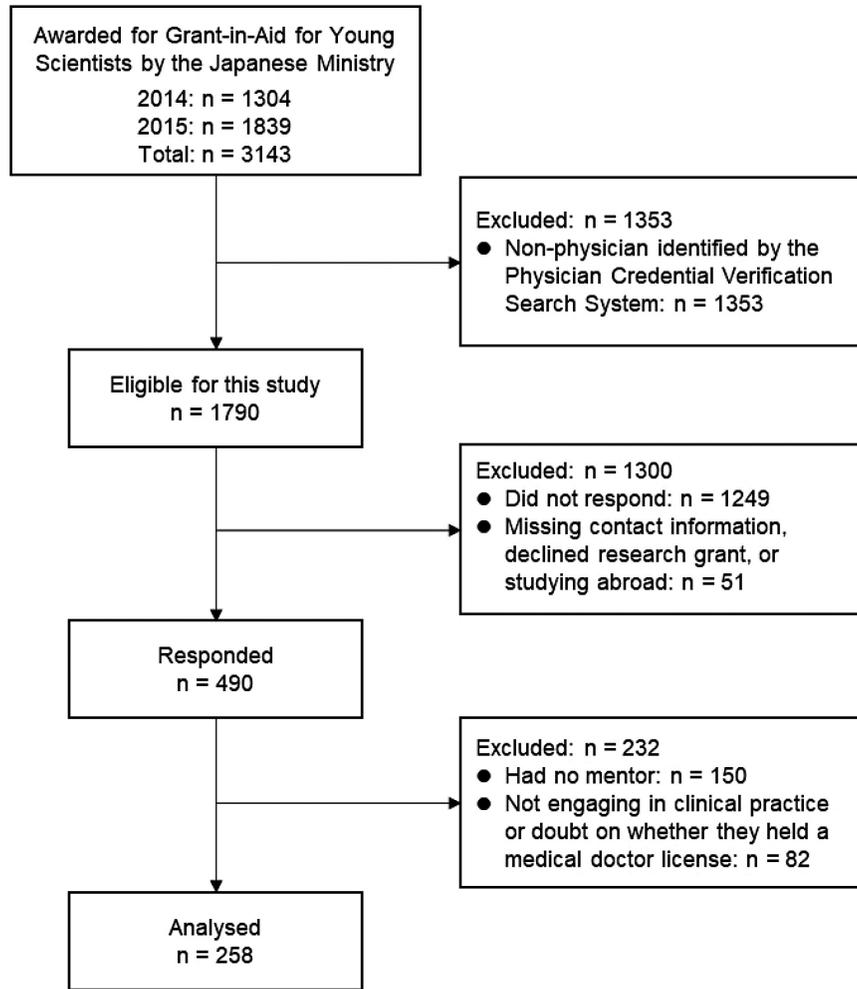


Fig 1. Study flow chart of this study.

mentor ($p = 0.009$). Female mentees were more likely to have a paternalistic relationship with their mentors than were male mentees ($p = 0.011$). There was no significant difference between male and female physicians in their mentors' affiliation, how to find a mentor, who to make first contact with when they needed to talk, and the frequency of meeting mentors face-to-face.

Great research mentors for young physician researchers scale development

Table 2 shows the results of the unweighted least-squares method for an exploratory factor solution using varimax rotation. The KMO index was 0.887, which is considered meritorious (Beavers et al. 2013). A scree plot revealed three factors with eigenvalues over 1.0 for the 35 items. We excluded 20 items out of the 35 items that either did not have factor loadings exceeding 0.6 for any factor or had the same factor loading on 2-3 different factors.

We identified three relevant factors that describe mentors' characteristics. The first factor included six items: "Active listener," "Motivator," "Sincerely wants to offer help in the mentee's best interest," "Sincerely dedicated to

developing a trust relationship with a mentee," and "Understanding." We named the first factor "Building a good trust relationship." The second factor included six items: "Helping to articulate a vision for the mentee's future," "Advise regarding the research grant," "Offering opportunities to participate in new research projects," "Advise regarding professional advancement," "Promoting the mentee's career opportunities through their networking," and "Having high ethical standards as a researcher." We named this second factor "Mentorship in research." Finally, the third factor included three items: "Well-respected in their research field," "Authorized in their research field" and "Knowledgeable, and experienced." We named this factor "Established and authorized mentor." The mean values (SD) of each factor were as follows: Building a good trust relationship, 24.4 (4.3); Mentorship in research, 22.5 (4.9); and Established and authorized mentor, 13.4 (2.0). The correlation coefficients among the three factors ranged from 0.28-0.38. The Cronbach's alpha for these three factors ranged from 0.853-0.889.

Supplementary Table S2 shows a comparison of participant characteristics between those with higher and lower

Table 1. Characteristics of the mentees and their mentors.

Variables	All (n = 258) N (%)	Mentees' sex		p-values
		Male (n = 191) N (%)	Female (n = 67) N (%)	
Mentee's characteristics				
Age, years (mean ± SD)	36.4 ± 2.8	36.4 ± 2.8	36.5 ± 2.6	0.781
Physician experience, years (mean ± SD)	11.7 ± 2.7	11.6 ± 2.8	12.1 ± 2.5	0.229
Not married	42 (16.3)	23 (12.0)	19 (28.4)	0.002*
Workplace				0.967
Teaching hospitals	213 (82.9)	155 (81.2)	58 (87.9)	
Hospitals	26 (10.1)	21 (11.0)	5 (7.6)	
Clinics	18 (0.1)	15 (7.9)	3 (4.6)	
Department				0.967
Basic/Social Science	44 (17.3)	32 (17.0)	12 (17.9)	
Surgery	105 (41.2)	77 (41.0)	28 (41.8)	
Internal Medicine	106 (41.6)	79 (42.0)	27 (40.3)	
Research type				0.192
Basic science	142 (55.3)	110 (57.6)	32 (48.5)	
Clinical science	96 (37.4)	66 (34.6)	30 (45.5)	
Social medicine	15 (0.1)	13 (6.8)	2 (3.0)	
Others	4 (0.0)	2 (1.1)	2 (3.0)	
Doctor of Medical Science	183 (70.9)	131 (68.6)	52 (77.6)	0.162
Board certified specialist	239 (93.0)	176 (95.3)	63 (94.0)	0.612
Weekly working times, h/week (mean ± SD)	59.5 ± 17.0	62.6 ± 15.8	50.6 ± 17.2	< 0.0001*
Satisfaction with the current mentor [#]	228 (88.7)	166 (86.9)	62 (92.5)	0.120
Psychological burnout (mean ± SD)				
Personal burnout	37.9 (20.7)	34.9 (20.3)	37.0 (18.9)	0.466
Work-related burnout	29.0 (18.0)	27.4 (17.0)	25.1 (15.2)	0.321
Client-related burnout	27.9 (17.9)	26.4 (15.4)	23.5 (16.2)	0.188
Mentor's characteristics				
Sex				0.009*
Male	246 (95.4)	186 (97.4)	60 (89.6)	
Female	12 (4.7)	5 (2.6)	7 (10.5)	
Affiliation				0.855
Chief of the mentee's department	94 (37.0)	71 (37.8)	23 (34.9)	
Another researcher in the mentee's department	93 (36.6)	67 (35.6)	26 (39.4)	
Researcher out of the department of mentee	67 (26.4)	50 (26.6)	17 (25.8)	
How did you find a mentor?				0.734
By a mentee	74 (28.8)	53 (27.9)	21 (31.3)	
By department	174 (67.7)	131 (69.0)	43 (64.2)	
Others	9 (3.5)	6 (3.2)	3 (4.5)	
Which one of you or your mentor makes the first contact when you need to talk?				0.177
By mentee	140 (54.3)	110 (57.6)	30 (44.8)	
By mentee or mentor	110 (42.6)	75 (39.3)	35 (52.2)	
By mentor	8 (3.1)	6 (3.1)	2 (3.0)	
Frequency of face-to-face meetings with the mentor				0.308
Everyday or 4-5 times/week	63 (24.6)	51 (27.0)	12 (17.9)	
1-3 times/week	87 (34.0)	59 (31.2)	28 (41.8)	
One time/2 weeks-1 month	62 (24.2)	45 (23.8)	17 (25.4)	
Less than one time/2 months	44 (17.2)	34 (18.0)	10 (14.9)	
Mentor-mentee relationship				0.011*
Paternalistic	117 (45.4)	78 (40.8)	39 (58.2)	
Intermediate	73 (28.3)	63 (33.0)	10 (14.9)	
Equal	68 (26.4)	50 (26.2)	18 (26.9)	

[#]We classified Mentees' satisfaction into a binary index (0-3, not satisfied, and 4-5, satisfied). *p < 0.05.

Table 2. Results of factor analysis, correlations between three factors, and Cronbach α of each factor (n = 258).

Items	Factor 1	Factor 2	Factor 3
Building good trust relationship			
Active listener	0.756	-0.005	0.109
Motivator	0.754	0.167	0.186
Sincerely wants to offer help in mentee's best interest	0.748	0.175	0.089
Sincerely dedicated to develop trust relationship with a mentee	0.734	0.198	-0.032
Understanding	0.729	0.093	0.056
Able to maximize potential strengths of a mentee	0.685	0.247	0.198
Mentorship in research			
Helping to articulate vision for his/her future	0.115	0.714	0.115
Advise for research grant	0.340	0.691	0.179
Offering opportunities to participate in new research projects	0.218	0.689	-0.035
Advise for professional advancement	0.278	0.679	0.071
Promoting mentee's career opportunities through his/her networking	0.025	0.665	0.150
Having high ethical standards as a researcher	-0.023	0.623	0.241
Established and authorized mentor			
Well-respected in his/her research field	0.172	0.130	0.926
Authorized in his/her research field	0.033	0.181	0.859
knowledgeable and experienced	0.197	0.171	0.680
Correlation coefficient between three factors	1.000	0.380	0.283
	0.380	1.000	0.331
	0.283	0.331	1.000
Cronbach α	0.889	0.853	0.882

scores for each factor. Participants with lower scores on the building good trust relationship subscale were slightly younger than those with higher scores ($p = 0.010$). They were more likely to be in the Department of Basic/Social Science or Internal Medicine ($p = 0.049$). In addition, the percentage of DMSc holders tended to be lower among participants with lower subscale scores than among those with higher scores ($p = 0.075$). Participants with higher scores in the "Established and authorized mentor" subscale were slightly older than those with higher scores ($p = 0.067$). They were more likely to have a male mentor ($p = 0.002$) or a mentor who was the chief of the mentee's department ($p = 0.001$). The percentages of paternalistic mentor-mentee relationships tended to be higher in participants with higher scores in the "Established and authorized mentor" subscale than those with lower scores. In contrast, the percentage of equal mentor-mentee relationships tended to be lower ($p = 0.099$). Participants with lower scores in "Mentorship in Research" were more likely to find their mentor by themselves ($p = 0.004$). We did not find other apparent differences in mentees and their mentors' characteristics between participants with lower and higher scores in "Mentorship in Research."

Mentees' satisfaction with their mentors

The participants were asked about their satisfaction with their mentors. All three domains were positively associated with satisfaction with their mentors: Factor 1:

Building a good trust relationship (OR 1.40, 95% CI:1.24-1.58), Factor 2: Mentorship in research (OR 1.19, 95% CI:1.10-1.29), and Factor 3: Established and authorized mentor (OR 1.49, 95% CI:1.24-1.80).

Association of the scale with psychological burnout

Tables 3, 4 and 5 show the associations between the Great Research Mentors for Young Physician Researchers scale and psychological burnout. "Mentorship in research" was inversely associated with PBO in a univariate model ($\beta = -6.5$, $p = 0.009$) and a multivariate model ($\beta = -6.25$, $p = 0.014$) after adjusting for age, sex, and broad certified specialist (Table 3). "Building a good trust relationship" and "Established and authorized mentor" were not significantly associated with PBO.

"Mentorship in research" was also inversely associated with WBO ($\beta = -4.76$, $p = 0.029$) in a multivariate model after adjusting for age, sex, and average weekly working times (Table 4). "Building a good trust relationship" showed a significant negative association with WBO in a univariate model ($\beta = -4.19$, $p = 0.043$) but not in a multivariate model ($\beta = -2.97$, $p = 0.176$). In addition, average weekly working hours were positively associated with WBO in both models. No significant associations were observed between other variables and WBO.

A negative association between "Building a good trust relationship" and CBO was observed ($\beta = -4.91$, $p = 0.014$), even after adjusting for age, sex, and mentees'

Table 3. Factors associated with personal burnouts (n = 258).

Variables	Personal burnout					
	Univariate model			Multivariate model		
	beta	SE	p	beta	SE	p
A scale for a great research mentor						
Factor 1: Building good trust relationship	-3.11	2.48	0.210			
Factor 2: Mentorship in research	-6.50	2.46	0.009 [#]	-6.25	2.52	0.014*
Factor 3: Established and authorized mentor	0.46	2.50	0.853			
Mentees characteristics						
Age, years	-0.08	0.45	0.856	-0.11	0.47	0.819
Sex			0.466			0.694
Male	2.07	2.83		1.15	2.91	
Female	Ref	Ref		Ref	Ref	
Years of experience as a physician, years	-0.24	0.47	0.610			
Marriage Status			0.929			
Married	0.3	3.37				
Not married	Ref	Ref				
Workplace			0.288			
Teaching hospitals	-4.92	4.9				
Hospitals	-9.58	6.12				
Clinics	Ref	Ref				
Department			0.644			
Basic/Social Science	-0.98	3.58				
Surgery	-2.57	2.75				
Internal Medicine	Ref	Ref				
Research type			0.457			
Basic science	-2.41	2.64				
Clinical science	3.12	4.88				
Social medicine/others	Ref	Ref				
Doctor of Medical Science	1.01	2.74	0.713			
Board certified specialist	-8.06	4.73	0.090 [#]	-7.77	5.21	0.137
Average weekly working times, h/week	0.07	0.07	0.308			
Mentors characteristics						
Sex			0.428			
Male	4.68	5.9				
Female	Ref	Ref				
Affiliation			0.696			
Chief of the mentee's department	-2.44	3.2				
Another researcher of the mentee's department	-0.43	3.2				
Researcher out of the department of mentee	Ref	Ref				
Mentor-mentee relationship			0.307			
Paternalistic	4.66	3.04				
Intermediate	2.59	3.36				
Equal	Ref	Ref				

Multivariate regression model included variables with $p < 0.1$ in univariate models, age, and sex as covariates.

[#] $p < 0.1$ in univariate regression models; * $p < 0.05$ in a multivariate regression model.

department (Table 5). The mentee's department was significant in the univariate model ($p = 0.025$), but not in the multivariate model ($p = 0.061$). The other variables were not significantly associated with CBO.

Discussion

In this study, we developed a scale of great research mentors by using young physician scientists who won prestigious scientific research funding. The scale development

Table 4. Factors associated with work-related burnouts (n = 258) .

Variables	Work-related burnout					
	Univariate model			Multivariate model		
	beta	SE	p	beta	SE	p
A scale for a great research mentor						
Factor 1: Building good trust relationship	-4.19	2.06	0.043 [#]	-2.97	2.19	0.176
Factor 2: Mentorship in research	-5.59	2.06	0.007 [#]	-4.76	2.17	0.029*
Factor 3: Established and authorized mentor	-1.28	2.09	0.541			
Mentees characteristics						
Age, years	-0.19	0.38	0.622	-0.21	0.39	0.583
Sex			0.321			0.747
Male	-2.34	2.35		-0.82	2.54	
Female	Ref	Ref		Ref	Ref	
Years of experience as a physician, years	-0.25	0.39	0.516			
Marriage Status			0.310			
Married	Ref	Ref				
Not married	-2.84	2.8				
Workplace			0.471			
Teaching hospitals	-2.32	4.07				
Hospitals	-5.88	5.09				
Clinics	Ref	Ref				
Department			0.613			
Basic/Social Science	-1.73	2.99				
Surgery	-2.22	2.3				
Internal Medicine	Ref	Ref				
Research type			0.198			
Basic science	-3.78	2.19				
Clinical science	0.54	4.04				
Social medicine/others	Ref	Ref				
Doctor of Medical Science	0.5	2.28	0.825			
Board certified specialist	-2.94	3.95	0.458			
Average weekly working times, h/week	0.14	0.06	0.018 [#]	0.14	0.06	0.033*
Mentors characteristics						
Sex			0.751			
Male	-1.56	4.91				
Female	Ref	Ref				
Affiliation			0.339			
Chief of the mentee's department	-3.93	2.67				
Another researcher of the mentee's department	-2.31	2.67				
Researcher out of the department of mentee	Ref	Ref				
Mentor-mentee relationship			0.808			
Paternalistic	1.56	2.54				
Intermediate	0.47	2.8				
Equal	Ref	Ref				

Multivariate regression model included variables with $p < 0.1$ in univariate models, age, and sex as covariates.

[#] $p < 0.1$ in univariate regression models; * $p < 0.05$ in a multivariate regression model.

identified three characteristics of a great research mentor including “Building a good trust relationship,” “Mentorship in research,” and “Established and authorized mentor.” We found that “Building a good trust relationship” and “Mentorship in research” were associated with a decreased

level of psychological burnout in young physician researchers, as expected based on our hypothesis. In addition to their high reliability and validity, the three domains were statistically associated with mentee satisfaction. This indicates that we were able to develop a reliable and valid scale

Table 5. Factors associated with client-related burnouts (n = 258) .

Variables	Client-related burnout					
	Univariate model			Multivariate model		
	beta	SE	p	beta	SE	p
A scale for a great research mentor						
Factor 1: Building good trust relationship	-4.15	1.94	0.034 [#]	-4.91	1.99	0.014*
Factor 2: Mentorship in research	-1.73	1.94	0.373			
Factor 3: Established and authorized mentor	1.39	1.96	0.479			
Mentees characteristics						
Age, years	0.34	0.36	0.340	0.31	0.36	0.392
Sex			0.188			0.241
Male	-2.93	2.22		-2.61	2.22	
Female	Ref	Ref				
Years of experience as a physician, years	0.25	0.36	0.488			
Marriage Status			0.533			
Married	Ref	Ref				
Not married	1.65	2.64				
Workplace			0.699			
Teaching hospitals	3.04	3.85				
Hospitals	1.81	4.81				
Clinics	Ref	Ref				
Department			0.025 [#]			0.061
Basic/Social Science	-5.1	2.76		-4.48	2.84	
Surgery	-5.46	2.12		-4.81	2.14	
Internal Medicine	Ref	Ref		Ref	Ref	
Research type			0.252			
Basic science	-2.12	2.07				
Clinical science	4.03	3.82				
Social medicine/others	Ref	Ref				
Doctor of Medical Science	2.16	2.15	0.315			
Board certified specialist	0.5	3.74	0.893			
Average weekly working times, h/week	0.06	0.06	0.269			
Mentors characteristics						
Sex			0.905			
Male	0.55	4.64				
Female	Ref	Ref				
Affiliation			0.192			
Chief of the mentee's department	-0.53	2.49				
Another researcher of the mentee's department	-3.98	2.5				
Researcher out of the department of mentee	Ref	Ref				
Mentor-mentee relationship			0.896			
Paternalistic	1.01	2.39				
Intermediate	0.2	2.65				
Equal	Ref	Ref				

Multivariate regression model included variables with $p < 0.1$ in univariate models, age, and sex as covariates.

[#] $p < 0.1$ in univariate regression models; * $p < 0.05$ in a multivariate regression model.

for a great research mentor and that a research mentor is encouraged to have both research mentorship and a good trust relationship with their mentees to provide mental health support.

Several studies were based on literature reviews or

professional opinions, referring to the characteristics of a great research mentor. Cho et al. (2011) reported the following lists of qualities of outstanding mentors through a qualitative analysis at a university in the U.S. :1) demonstrate admirable personal qualities; 2) serve as a profes-

sional mentor, providing a vision while carefully adapting support to each mentee; 3) make serious time commitments; 4) encourage a healthy balance between work and life; and 5) establish global norms and standards for mentorship through role modeling and the implementation of laws. Sambunjak et al. (2010) stated that influential mentors require commitment, interpersonal skills from mentors and mentees, and a supportive environment in academic medicine institutions. Although the expressions and terminologies used in our scale were different from the previous studies, the scale contained similar elements apart from “make a serious time commitment.” Nevertheless, our initial 35 items may not have sufficiently captured those identified in previous studies. Moreover, the research environment surrounding physician scientists may depend on a country’s research funding system, medical expenditure, or government agenda (Komiya et al. 2020). Thus, the scale of great mentors may need to be updated according to time requirements.

In the current study, we found that the subscale “Building a good trust relationship” was inversely associated with WBO and CBO, “Mentorship in research” was inversely associated with WBO and PBO, while “Established and authorized mentor” was not associated with any burnout subscale. According to Patel et al. (2018), burnout can be attributed to factors such as high stress levels, clerical duties, and workload. Physicians have reported individually focused and structural/organizational strategies as prophylactic factors (West et al. 2016). The authors have previously shown that offering consultation services can reduce burnout among faculty members in Japanese academia, resulting in the increased retention of academic researchers (Perumalswami et al. 2020). Our results emphasize the importance of good mentee-mentor relationships in preventing psychological burnout among young physicians, supporting previous findings.

First, “Building a good trust relationship” was inversely associated with not only WBO but also CBO. In a meta-analysis, Roorda et al. (2011) showed that good teacher–student relationships positively impact students’ school adjustment, social functioning, behavioral problems, engagement in learning activities, and academic achievement through emotional security. Therefore, “Building a good trust relationship” with mentors had positive associations with mentees’ CBO, which may be partially explained by interactions with their patients. Second, “Mentorship in research” was inversely associated with WBO, which is perceived as related to their work (including research activity and clinical practice), and PBO, which is a state of prolonged physical and psychological exhaustion. In a business setting, continuous on-the-job training positively affects job satisfaction (Georgellis and Lange 2007). On-the-job training regarding research activity, which occupies a large portion of mentees’ lives among young physician researchers, might reduce not only WBO but also PBO by lowering the levels of WBO when the research activity

goes well. Lastly, “Established and authorized mentor” was not associated with burnout subscales. There are several possible explanations for these results. One is that a good relationship between mentees and mentors and guidance on research activities, rather than the mentor’s authority or past achievements, are crucial for preventing burnout among young physician researchers. A second possible reason is that the participants received prestigious research grants and most belonged to academic institutions. This leads to less variability in the scores of “Established and authorized mentor,” which can contribute to no apparent association between the subscale “Established and authorized mentor” and burnout.

Although some previous studies have qualitatively clarified the potential pivotal factors for developing a good relationship between mentors and mentees by summarizing the literature, few studies have attempted to show which factor is necessary to become a great mentor using quantitative data. To the best of our knowledge, no study has demonstrated how mentors’ core factors influence mentees’ psychological activities. This study was the first to develop a checklist using quantitative data collected from mentees. Moreover, we demonstrated that the high scores in the “Building a good trust relationship” and “Mentorship in research” subscales were associated with lower levels of psychological burnout. The mentor checklist can be implemented as a self-monitoring tool for mentors and mentees currently working in academia to understand the characteristics of mentors that positively impact mentees’ psychological well-being and to evaluate what is lacking in their mentor-mentee relationship. In addition, individuals who will serve as mentors can refer to this checklist to know crucial mentors’ characteristics required for preventing their mentees’ psychological burnout.

The present study has strength and limitations. The strength of this study is that all three domains were positively associated with mentees’ satisfaction with their mentors (data shown in the Results section), proving the convergent validity of this checklist. Thus, the scale exhibits excellent practicality. There is no assessment tool available to quantitatively assess great research mentors; therefore, this is the first practical scale of great research mentors that enables us to evaluate the characteristics of mentors of young physician researchers.

Nonetheless, our findings require careful interpretation owing to the following limitations. First, in addition to the sample size, we surveyed only mentees’ perspectives. Focusing solely on mentees’ opinions may overlook the essential factors required by mentees to improve the quality of their research and productivity. Therefore, a mutual evaluation, including the perspectives of mentees and mentors, is required. Second, adjustments for depression symptoms and private events, such as losing a loved one, are ideally needed to test the association of the mentor-mentee relationship with psychological burnout (Justice et al. 1981; Iacovides et al. 2003). Adjustments for the outcome predic-

tors (psychological burnout) were not necessary for causal inference. Additionally, our participants were less likely to have severe health problems and adverse life events because they were a young working population. Third, the response rate remained at 28.2%, which may have led to a sampling bias; therefore, generalizability was limited. Fourth, owing to the small sample size, we could not conduct confirmatory factor analysis and test-retest reliability. Thus, our scale was suggestive, and our primary finding was that a good trust relationship between mentees and mentors was associated with a decreased level of burnout, in addition to research mentorship. Lastly, although regression analyses did not find apparent associations between the sexes of mentors and mentees and psychological burnout, we were not able to test the possibility of an effect modification between mentees and mentors sex on the results due to the very low number of female mentors. For example, female mentors can easily account for not only their female mentees research activity but also the distinct health conditions prevalent in females than male mentors. This may reduce the level of psychological burnout. Thus, future studies are required.

In conclusion, we developed a reliable and valid scale for the research mentors of young physician researchers in this study. Better mentee-mentor relationships and mentorship in research activities were associated with decreased levels of psychological burnout. This index may need to be updated according to the working environment and resources surrounding physician scientists with larger sample sizes and more rigorous methodologies.

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Author Contributions

Conception or design of the work: S.T. and K.N.; acquisition of data: S.T. and K.N.; analysis of data: S.T., T.N., K.N., and M.I.; interpretation of data: S.T., M.I., and K.N.; drafting or substantively revising the work: S.T., M.I., and K.N.

Conflict of Interest

The authors declare no conflict of interest.

References

- Beavers, A.S., Lounsbury, J.W., Richards, J.K., Huck, S.W., Skolits, G. & Esquivel, S.L. (2013) Practical considerations for using exploratory factor analysis in educational research. *Pract. Assess. Res. Evaluation*, **18**, 1-13.
- Cho, C.S., Ramanan, R.A. & Feldman, M.D. (2011) Defining the ideal qualities of mentorship: a qualitative analysis of the characteristics of outstanding mentors. *Am. J. Med.*, **124**, 453-458.
- DeCastro, R., Griffith, K.A., Ubel, P.A., Stewart, A. & Jagsi, R. (2014) Mentoring and the career satisfaction of male and female academic medical faculty. *Acad. Med.*, **89**, 301-311.
- Farrugia, P., Petrisor, B.A., Farrokhyar, F. & Bhandari, M. (2010) Practical tips for surgical research: research questions, hypotheses and objectives. *Can. J. Surg.*, **53**, 278-281.
- Fukuhara, S. (2006) Cultivation of new research community by clinical researchers in Japan: a strategy and roadmap. *TRENDS IN THE SCIENCES*, **11**, 43-52 (in Japanese).
- Georgellis, Y. & Lange, T. (2007) Participation in continuous, on-the-job training and the impact on job satisfaction: longitudinal evidence from the German labour market. *Int. J. Hum. Resour. Manag.*, **18**, 969-985.
- Iacovides, A., Fountoulakis, K.N., Kaprinis, S. & Kaprinis, G. (2003) The relationship between job stress, burnout and clinical depression. *J. Affect. Disord.*, **75**, 209-221.
- Ishikawa, T., Ohba, H., Yokooka, Y., Nakamura, K. & Ogasawara, K. (2013) Forecasting the absolute and relative shortage of physicians in Japan using a system dynamics model approach. *Hum. Resour. Health*, **11**, 41.
- Japan Society for the Promotion of Science (2022) Types of Grants-in-Aids for Scientific Research. <https://www.jsps.go.jp/english/e-grants/grants01.html> [Accessed: October 23, 2023].
- Justice, B., Gold, R.S. & Klein, J.P. (1981) Life events and burnout. *J. Psychol.*, **108**, 219-226.
- Kobayashi, Y. & Takaki, H. (1992) Geographic distribution of physicians in Japan. *Lancet*, **340**, 1391-1393.
- Komiya, T., Chaaya, G., Deshotels, L. & Wang, A. (2020) Difference of environment behind research and clinical practice between USA and Japan. *J. Thorac. Dis.*, **12**, 3804-3808.
- Kristensen, T.S., Borritz, M., Villadsen, E. & Christensen, K.B. (2005) The Copenhagen Burnout Inventory: a new tool for the assessment of burnout. *Work Stress*, **19**, 192-207.
- Ministry of Education, Culture, Sports, Science and Technology (2022) 2022 Edition of the White Paper on Science, Technology, and Innovation. https://www.mext.go.jp/b_menu/hakusho/html/hpaa202201/1421221_00003.html [Accessed: October 23, 2023] (in Japanese).
- Nomura, K. (2011) Physician shortage in Japan: the new postgraduate medical education program and physicians as a human medical resource. *Nihon Eiseigaku Zasshi*, **66**, 22-28 (in Japanese).
- Organisation for Economic Cooperation and Development (OECD) (2021) Health at a Glance. https://www.oecd-ilibrary.org/social-issues-migration-health/health-at-a-glance-2021_ae3016b9-en [Accessed: October 21, 2023].
- Patel, R.S., Bachu, R., Adikey, A., Malik, M. & Shah, M. (2018) Factors related to physician burnout and its consequences: a review. *Behav. Sci. (Basel)*, **8**, 98.
- Perumalswami, C.R., Takenoshita, S., Tanabe, A., Kanda, R., Hiraike, H., Okinaga, H., Jagsi, R. & Nomura, K. (2020) Workplace resources, mentorship, and burnout in early career physician-scientists: a cross sectional study in Japan. *BMC Med. Educ.*, **20**, 178.
- Roorda, D.L., Koomen, H.M.Y., Spilt, J.L. & Oort, F.J. (2011) The influence of affective teacher-student relationships on students' school engagement and achievement: a meta-analytic approach. *Review of Educational Research*, **81**, 493-529.
- Sambunjak, D., Straus, S.E. & Marusic, A. (2010) A systematic review of qualitative research on the meaning and characteristics of mentoring in academic medicine. *J. Gen. Intern. Med.*, **25**, 72-78.
- Statistics Bureau, Ministry of Internal Affairs and Communications Japan (2023) STATISTICAL HANDBOOK OF JAPAN 2023. <https://www.stat.go.jp/english/data/handbook/index.html> [Accessed: October 21, 2023].
- Taka, F., Nomura, K., Horie, S., Takemoto, K., Takeuchi, M., Takenoshita, S., Murakami, A., Hiraike, H., Okinaga, H. &

- Smith, D.R. (2016) Organizational climate with gender equity and burnout among university academics in Japan. *Ind. Health*, **54**, 480-487.
- Takenoshita, S., Nomura, K., Ohde, S., Deshpande, G.A., Sakamoto, H., Yoshida, H., Urayama, K., Bito, S., Ishida, Y., Shimbo, T., Matsui, K., Fukui, T. & Takahashi, O. (2016) Having a mentor or a doctoral degree is helpful for mid-career physicians to publish papers in peer-reviewed journals. *Tohoku J. Exp. Med.*, **239**, 325-331.
- Toyoshima, M., Takenoshita, S., Hasegawa, H., Kimura, T. & Nomura, K. (2020) Experiences of negotiations for improving research environment and burnout among young physician researchers in Japan. *Int. J. Environ. Res. Public Health*, **17**, 5221.
- West, C.P., Dyrbye, L.N., Erwin, P.J. & Shanafelt, T.D. (2016) Interventions to prevent and reduce physician burnout: a systematic review and meta-analysis. *Lancet*, **388**, 2272-2281.
- West, C.P., Dyrbye, L.N. & Shanafelt, T.D. (2018) Physician burnout: contributors, consequences and solutions. *J. Intern. Med.*, **283**, 516-529.

Supplementary Files

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