

Work stress and workload of full-time anesthesiologists in acute care hospitals in Japan

KAZUYOSHI KAWASAKI^{1,2}, MIHO SEKIMOTO², TATSURO ISHIZAKI², and YUICHI IMANAKA²

¹Department of Anesthesia, Sanraku Hospital, 2-5 Kanda-Surugadai, Chiyoda-ku, Tokyo 101-8326, Japan

²Department of Healthcare Economics and Quality Management, Kyoto University Graduate School of Medicine, Kyoto, Japan

Abstract

Purpose. The number of anesthesiologists per population in Japan is small compared with that in Europe and North America. While there is a growing concern that hard work causes anesthesiologists' fatigue and may compromise patient safety, the workload and physical stress, as well as the impact of staff support on physicians' stress have not been assessed in detail. The goal of this study was to evaluate the working environment, anesthesia workload, and occupational stress of anesthesiologists in Japan.

Methods. A questionnaire survey was performed targeting 1010 members of the Japanese Society of Anesthesiologists working as anesthesiologists affiliated with acute care hospitals in Japan. Data on background information, working environment, operation anesthesia duties, and stress were collected, and the relationship of work stress with background, environment, and anesthesia duties was evaluated by linear regression analysis.

Results. Responses were obtained from 383 full-time anesthesiologists (response rate, 43.9%). The total anesthesia time per week was 23.6 h on average. The work stress score was 114.3 ± 30.2 (mean \pm SD) when the average workers' work stress score in Japan was 100. The work stress score was significantly associated with "years of experience" (with experience < 10 years considered as the reference; 10–19 years: $\beta = -0.18$, $P = 0.02$, ≥ 20 years: $\beta = -0.15$, $P = 0.04$), "hospital with ≥ 500 beds" (with a hospital with ≤ 299 beds considered as the reference; $\beta = 0.15$, $P = 0.04$), "total time of anesthesia per week" ($\beta = 0.18$, $P = 0.02$), "estimated annual cases managed by an anesthesiologist" ($\beta = 0.12$, $P = 0.04$) and "no-support stress" ($\beta = 0.21$, $P < 0.01$) on linear regression analysis ($R^2 = 0.12$).

Conclusion. Our results provide a quantitative assessment of the duties of anesthesiologists and show that work stress

among anesthesiologists is related to workload and other factors.

Key words Anesthesiologist · Workload · Stress · Factors causing stress

Introduction

The shortage of anesthesiologists has become a concern for surgeons [1,2], and is now considered to be a social problem. In Japan, there were only 3.9 anesthesiologists per 100 000 people in 2004 [3], compared to 13.8 in the United States [4]; in the European Union and the United Kingdom these numbers are 9.2 and 4.6, respectively [5,6]. There are also large differences in the numbers of anesthesiologists between regions and facilities in Japan; Mizuno et al. [3] reported that the number of anesthesiologists per 1000 beds in Mie Prefecture was only 1.6, whereas that in Tokyo was 5.3. According to the membership list published by the Japanese Society of Anesthesiologists, the number of members differs significantly between regions, indicating the uneven distribution of anesthesiologists in Japan.

The lack of and maldistribution of anesthesiologists increase workload and work-related stress [7], and a vicious circle may be created as anesthesiologists leave their work due to the heavy workload. Therefore, it is important to clarify the relationship between workload and stress in anesthesiologists. However, the actual working time of anesthesiologists in surgery has not been established, in part because many anesthesiologists have roles in pain clinics, palliative medicine, intensive care units (ICUs), critical care, and hospital management, and so it is difficult to obtain data for workload for individual anesthesiologists. In addition, there are many physicians who do not work as anesthesiologists although they are qualified to do so.

Address correspondence to: K. Kawasaki

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Therefore, the collection of data on the workload and background of individual anesthesiologists is required to clarify the current workload and to assess stress. An understanding of differences in workload among medical facilities and the working burden is also important for the evaluation of labor shortages and stress among anesthesiologists. This study aimed to investigate the relationship between workload and stress in anesthesiologists.

Subjects and methods

Subjects

The study was performed in members of the Japanese Society of Anesthesiologists (JSA) who work as full-time anesthesiologists at acute care hospitals; university hospitals (including associated hospitals) were excluded. In addition, physicians who were members of the JSA and employed at a Department of Anesthesia of an acute care hospital (excluding trainee physicians) were defined as anesthesiologists. After obtaining agreement from the JSA, we selected 1010 members (about 1 out of every 9 anesthesiologists from the JSA membership list [web version] which was published in August 2005 and included approximately 9000 members in total). If an anesthesiologist who worked at a university hospital was initially selected, the next listed anesthesiologist who worked at an acute care hospitals was chosen instead. Self-administered anonymous questionnaires were sent to the selected anesthesiologists by mail, together with a written explanation of the questionnaire, the objectives of the questionnaire, methods, and a request for voluntary participation. Return of the questionnaire was considered to indicate an agreement to participate in the study.

Methods

This study was performed after obtaining permission from the ethics committee of Kyoto University Graduate School of Medicine. The questionnaire was sent to the anesthesiologists in October 2005 with a request that answers should be returned using the enclosed envelope by December 31, 2005. A postcard was also sent to each anesthesiologist 2 weeks after distribution of the questionnaire to remind them to send back their answers.

The survey requested information on the personal background, medical facility, workload of anesthesia in surgery, and stress. The personal background included sex, years of experience, major work, duty/on-call system, and work other than anesthesia in surgery. Regarding the medical facility, questions were asked

about the number of full-time and part-time anesthesiologists and the number of anesthetics performed per year. To investigate the weekly workload of anesthesia in surgery, the subjects were requested to record the starting and completion times of anesthesia in each surgery every day during a week: the week starting on October 3, 2005, or the previous week if the designated week was not representative due to holidays of staff members or participation in an academic meeting. Stress was investigated using 12 mandatory questions selected from the Japanese version of the Job Content Questionnaire (see Appendix) and the answers were recorded as scores using a "diagram for measuring occupational stress", with reference to the "Study on Prevention of Work-Related Diseases" performed from 1995 to 1999 by the Ministry of Labor [8,9]. This approach allows data to be obtained for stress related to "psychological demands" and "decision latitude" (hereinafter referred to as work stress) and for stress related to "support of superiors" and "support of colleagues" (hereinafter referred to as no-support stress). Each stress score was interpreted by calculating stress-related health problems as the "health risk," assuming an average score of 100 for the standard group (an average score was calculated from 25 000 workers); thus, a score of 120 indicates an increase of 20% in the development of health problems.

Statistical analysis

The values for results were presented as means; SDs; 25th, 50th, and 75th percentiles; or percentages.

The working environment at medical facilities was determined as the estimated annual number of cases managed by an anesthesiologist. This estimation was made by dividing the number of anesthetics performed per year at each institution by the number of full-time and part-time anesthesiologists at that institution.

The workload of an anesthesiologist in surgery was determined as the total anesthesia time per week, on-duty (times/month) and on-call (times/month).

The stress was determined as work stress and no-support stress.

To examine the characteristics of anesthesiologists with a heavy workload of anesthesia in surgery, the data for the group who had a total anesthesia time per week above the 75th and 95th percentiles were recorded for the background, working environment at the medical facility, and stress.

To examine the relationships of work stress with background, work environment, workload, and no-support stress, the subjects were divided into two or three groups based on each factor. Differences in work stress between pairs of groups were tested statistically using a Dunnett test.

To examine the relationships of work stress and other factors, multiple linear regression analysis was performed with work stress used as the objective variable. As the explanatory variables, sex and years of experience were used to define the characteristics of individual anesthesiologists; the number of beds was used to define the medical facility; work in an ICU/critical care department and the number of duties/on-call work was used to define the personal working environment; the total anesthesia time per week and estimated annual number of cases managed by an anesthesiologist was used to define personal workload; and no-support stress was used to define support at work.

All analyses were performed using SPSS 11.0J for Windows (SPSS Japan, Tokyo, Japan), with a level of 5% used to define significance (two-sided test).

Results

Questionnaires were sent to 1010 anesthesiologists, but 65 were returned as wrongly addressed. Of the 945 effective mailings, answers were obtained from 415 subjects. The response rate showed regional differences (26.1% in the Tokyo area, compared to 51.9% in Kyushu). The number of responses obtained from full-time anesthesiologists (the subjects of this study) was 383.

The background of the 383 subjects, estimated annual number of cases managed by an anesthesiologist, workload, and stress are shown in Table 1. Mean values of

114.3 for the work stress score and 100.5 for the no-support stress score were obtained from the stress questionnaire.

The backgrounds of the subjects, estimated annual number of cases managed by an anesthesiologist, and stress score for anesthesiologists with the top 25% (≥ 32.6 h; $n = 99$) and top 5% (≥ 47.0 h; $n = 17$) total anesthesia times per week are shown in Table 2.

The subjects were divided into two or three groups based on individual factors, and differences in work stress were examined among these groups. As shown in Table 3, significant differences were found for hospital bed numbers, total anesthesia time per week, estimated annual number of cases managed by an anesthesiologist, and no-support stress, indicating that these factors have an association with work stress.

The results of multiple linear regression analysis using these factors are shown in Table 4. The factors with a significant association with stress, in descending order of standard regression coefficient, were as follows: “no-support stress” (standard coefficient, $\beta = 0.21$, $P < 0.01$); “years of experience” (with experience < 10 years considered as the reference; 10–19 years: $\beta = -0.18$, $P = 0.02$, ≥ 20 years: $\beta = -0.15$, $P = 0.04$); “total anesthesia time per week” ($\beta = 0.18$, $P = 0.02$); “hospital beds” (with a hospital with ≤ 299 beds considered as the reference, hospitals with ≥ 500 beds: $\beta = 0.15$, $P = 0.04$); and “estimated annual number of cases managed by an anesthesiologist,” $\beta = 0.12$, and $P = 0.04$. Regarding “hospital beds,” work stress was higher in hospitals with 500 beds or more than in hospitals with 299 or fewer beds.

Table 1. Background of subjects ($n = 383$)

	Mean (SD)	Percentile		
		25 th	50 th	75 th
Background				
Years of experience	16.9 (7.9)	11	17	22
Male	67.6%			
Hospital with ≥ 500 beds	33.2%			
Intensive care	30.5%			
Critical care	21.7%			
Pain clinic	43.9%			
Education	51.4%			
Research	6.3%			
Administration	49.1%			
Working environment at medical facilities				
Estimated annual number of cases managed by an anesthesiologist (cases/anesthesiologist)	388.2 (172.6)	297.5	375	479
Workload for anesthesia in surgery and on duty/on-call				
Total anesthesia time per week (h)	23.6 (14.1)	15	23	33
On duty (times/month)	2.1 (2.8)	0.1	1.1	3.5
On-call work (times/month)	11.0 (10.2)	3.0	8.8	17.8
Stress				
No-support stress	100.5 (39.9)	72	97	127
Work stress	114.3 (30.2)	93	111	131

Table 2. Background, working environment at medical facilities, and stress in subjects with the top 25% and 5% total anesthesia times per week

	Total anesthesia time	
	≥75th Percentile (≥32.6 h) Mean (SD) (<i>n</i> = 99)	≥95th Percentile (≥47.0 h) Mean (SD) (<i>n</i> = 17)
Background of subjects		
Years of experience	14.8 (7.6)	13.9 (7.1)
Male (%)	72.0	73.7
Work at a hospital with 500 beds or more (%)	45.9	44.4
Working environment at medical facility		
Estimated annual number of cases managed by an anesthesiologist (cases/anesthesiologist)	459.4 (197.5)	519.2 (179.5)
Stress		
No-support stress	103.8 (40.0)	119.8 (48.6)
Work stress	125.9 (30.3)	141.4 (36.0)

Table 3. Relationship between work stress and individual variables

	Work stress value (SD)	<i>P</i> value
Years of experience		
≤10 years (<i>n</i> = 87) ^a	120.3 (31.5)	
10–19 years (<i>n</i> = 175)	113.2 (29.4)	0.12
≥20 years (107)	111.4 (30.2)	0.07
Sex		
Male (<i>n</i> = 257)	114.9 (33.5)	0.56
Female (<i>n</i> = 112)	113.0 (20.9)	
Hospital beds		
≤299 beds (<i>n</i> = 110) ^a	105.7 (30.7)	
300–499 beds (<i>n</i> = 140)	115.5 (28.3)	0.02
≥500 beds (<i>n</i> = 124)	120.3 (30.4)	0.01
Work in ICU or critical care department		
Yes (<i>n</i> = 148)	115.2 (30.2)	
No (<i>n</i> = 221)	113.8 (30.3)	0.66
Number of times on duty/on-call per month		
0–8 times (<i>n</i> = 140) ^a	111.2 (31.4)	
9–16 times (<i>n</i> = 119)	119.3 (29.2)	0.06
≥17 times (<i>n</i> = 108)	113.0 (29.6)	0.86
Total anesthesia time per week		
0–18 h (<i>n</i> = 129) ^a	107.9 (28.9)	
18.1–29 h (<i>n</i> = 124)	110.6 (27.4)	0.69
≥29.1 h (<i>n</i> = 116)	125.5 (31.8)	<0.01
Estimated annual number of cases managed by an anesthesiologist		
≤312 cases (<i>n</i> = 116) ^a	107.4 (31.0)	
312.1–433 cases (<i>n</i> = 117)	112.4 (25.0)	0.34
≥433.1 cases (<i>n</i> = 120)	123.1 (33.0)	<0.01
No-support stress		
≤100 (<i>n</i> = 202) ^a	111.5 (27.3)	
101–150 (<i>n</i> = 110)	118.2 (32.5)	0.11
≥151 (<i>n</i> = 38)	125.1 (35.4)	0.02

^aIndicates the category used as the reference

Regarding years of experience, work stress was lower in anesthesiologists with experience of 10–19 years and 20 or more years than in those with experience of less than 10 years. In these models, the determination coefficient was 0.12.

Discussion

The results of the survey of randomly selected anesthesiologists working at acute care hospitals in Japan provide clarification of the workload related to anesthe-

Table 4. Relationship between work stress and explanatory variables (multiple linear regression analysis)

	Nonstandard coefficient	Standard error	Standard coefficient	P value
Years of experience (10–19 years)	-10.80	4.40	-0.18	0.02
Years of experience (≥ 20 years)	-9.96	4.91	-0.15	0.04
Sex (male)	-0.26	3.70	-0.00	0.95
Hospital beds (300–499 beds)	3.65	4.23	0.06	0.39
Hospital beds (≥ 500 beds)	9.45	4.59	0.15	0.04
Work in ICU/critical care department	1.05	3.48	0.00	0.99
On duty/on-call (times/month)	-0.04	0.18	-0.02	0.80
Total anesthesia time per week	0.43	0.14	0.18	0.02
Estimated annual number of cases managed by an anesthesiologist (cases/year)	0.02	0.01	0.12	0.04
No-support stress	0.16	0.04	0.21	<0.01

Adjusted $R^2 = 0.12$

sia in surgery and work stress-associated factors. The average anesthesia work time was 23.6 h per week. We minimized the number of questions in the survey to increase the response rate, and questions regarding the workload for anesthesia (anesthesia time) were limited to anesthetic management. Therefore, the average anesthesia time per week of 23.6 h does not include related work such as preoperative consultation, preparation of the operation room, and postoperative follow up. In addition, as is clearly shown in Table 1, many anesthesiologists are involved in work other than anesthetic management, such as in intensive care, critical care, and pain clinics, as well as treatment, training, and administration, which leads to a large total workload.

The National Committee on Physician Manpower in Canada in the 1970s recommended that the ratio of anesthesiologists to the total population should be 1:13742, based on a working time of 54.4 h per week [10]. In 2006, just after the present study was performed, the number of anesthesiologists in Japan was estimated to be approximately 7000 and the national population to be about 120 million. This gives a ratio of anesthesiologists to the population of 1:17142, which is considerably smaller than that recommended by the National Committee on Physician Manpower. This suggests that the working time of anesthesiologists at acute care hospitals in Japan in 2006 was longer than 54.4 h per week.

We used the “estimated annual number of cases managed by an anesthesiologist” as a marker of the working environment at medical facilities. This number was determined by dividing the number of cases of surgery in a year at each facility in which anesthesia was performed by the number of anesthesiologists, and reflects the working environment of anesthesiologists at each facility. A mean of 388.2 cases per anesthesiologist per year was obtained, compared with values of 464.7 and 351.4 cases per anesthesiologist per year in ex-national hospitals and public hospitals, respectively,

found in a preliminary study in 2002 [11]. The differences between the results may be due to the limit of target hospitals to those with 500 beds or more and the inclusion of part-time anesthesiologists in the 2002 study.

In the present study, the average work stress of full-time anesthesiologists was 14.3% higher than that in the standard group, and the incidence of work-related health problems in approximately 25% of the anesthesiologists was 30% higher than that in the standard group, indicating a high-risk work situation. An investigation of health conditions of workers performed by the Ministry of Health, Labor, and Welfare has shown that the stress of workers in Japan has increased, and that the percentage of workers with “severe anxiety, troubles, and stress in their work and occupational life” increased from 50.6% in 1982 to 61.5% in 2002. In overseas reports, anesthesiologists have also been found to have more stress than other physicians [12,13], with the reasons for such severe stress including less satisfaction in their work, long working hours, on-call work, fear of court cases, and problems with relationships with physicians in other departments [14–16]. An investigation performed by the American Society of Anesthesiologists in 1991 indicated that the greatest stress was caused by on-call work at night, in addition to stress due to the requirement for anesthesia for patients at high risk, work responsibilities, and a heavy workload [17]. Based on our data, it appears likely that stress among anesthesiologists at acute care hospitals in Japan is considerable, although we have no evidence that this stress is higher than that in other physicians.

Predictably, workload (total anesthesia time per week and estimated annual number of cases managed by anesthesiologists) was significantly associated with work stress, but other factors (years of experience, support from other staff members, and hospital-related factors such as the number of hospital beds) may also be associated with work stress. There was a significant difference

in work stress between anesthesiologists with experience of 10 years or less and those with experience of 10 years or more. This suggests that anesthesiologists with experience of 10 years or more may have less stress due to improved anesthetic techniques, even with the same workload. In addition, Baker and Karasek [18] have suggested that social support (defined as no-support stress in the present study) may decrease stress related to “psychological demands” and “decision latitude” (defined as work stress in the present study). It has also been reported that stress is affected by social support from superiors or colleagues (that is, human relationships at work sites) [19] and our results suggest that work stress may decrease with increased support (decreased no-support stress), even with the same workload.

The number of hospital beds was also associated with work stress. The workload for anesthesia is increased in larger hospitals, but this does not simply mean that the workload will increase in larger hospitals because of the increased work burden. Rather, an anesthesiologist may have a larger technical burden in larger hospitals, because the various types of surgery performed at a hospital with a large number of beds may require special anesthesia techniques and work stress may also emerge from other work (e.g., education and administration), because this association was still observed even after adjustment for workload.

In the present study, the possible bias caused by lack of response could not be neglected, and the findings may not be generalizable to all anesthesiologists. However, the response rate was higher than that for past questionnaire surveys for physicians. The associations of work stress with factors such as workload, years of experience, hospital bed numbers, and support from other staff members were moderate and considered to be limited. However, the information collected in this study has not been reported previously, and thus we consider that the results provide a useful insight into the actual situation of anesthesiologists in Japan. We suggest that countermeasures based on the stress-related factors identified in this study should be taken to create a less stressful environment that will allow retention of the required number of anesthesiologists.

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Appendix. Stress questionnaire

- (1) You must work hard.
 - (2) You must do a lot of work.
 - (3) You cannot finish work on time.
 - (4) You can work in your own time.
 - (5) You can decide the order/method of the work by yourself.
 - (6) Your opinion can affect or reflect a policy of the workplace.
 - Who can you talk with comfortably at work?
 - (7) with your superiors
 - (8) with your colleagues
 - When you run into trouble, will you be given a helping hand?
 - (9) by your superiors
 - (10) by your colleagues
 - If you talk about your personal problems, who will give you a hand?
 - (11) your superiors
 - (12) your colleagues
-

Work stress: psychological demand = (1)+(2)+(3), decision latitude = (4)+(5)+(6)

No-Support stress: superior support = (7)+(9)+(11), colleague support = (8)+(10)+(12)

Each question had a 4-point response ranging from 1 (strongly disagree) to 4 (strongly agree)