

Exploring Attractiveness of the Basic Sciences for Female Physicians

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In Japan, traditional gender roles of women, especially the role of motherhood, may cause early career resignations in female physicians and a shortage of female researchers. Besides this gender issue, a general physician shortage is affecting basic science fields. Our previous study suggested that female physicians could be good candidates for the basic sciences because such work offers good work-life balance. However, the attractiveness for female physicians of working in the basic sciences, including work-life balance, is not known. In a 2012 nationwide cross-sectional questionnaire survey, female physicians holding tenured positions in the basic sciences at Japan's medical schools were asked an open-ended question about positive aspects of basic sciences that clinical medicine lacks, and we analyzed 58 respondents' comments. Qualitative analysis using the Kawakita Jiro method revealed four positive aspects: research attractiveness, priority on research productivity, a healthy work-life balance, and exemption from clinical duties. The most consistent positive aspect was research attractiveness, which was heightened by medical knowledge and clinical experience. The other aspects were double-edged swords; for example, while the priority on research productivity resulted in less gender segregation, it sometimes created tough competition, and while exemption from clinical duties contributed to a healthy work-life balance, it sometimes lowered motivation as a physician and provided unstable income. Overall, if female physicians lack an intrinsic interest in research and seek good work-life balance, they may drop out of research fields. Respecting and cultivating students' research interest is critical to alleviating the physician shortage in the basic sciences.

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Introduction

In Japan, the premature departure of female physicians from clinical settings and the few female researchers engaging in a research career are two important issues of gender bias in medical fields. Despite more female physicians having joined the workforce over the last three decades (Ministry of Health, Labour and Welfare of Japan 1985; Ministry of Health, Labour and Welfare, Tokyo Ministry of Health, Labour, and Welfare 2015), they tend to resign early in their careers, particularly in their late 20s to 30s (Kaneto et al. 2009), largely because of motherhood (Japan Medical Association 2009; Kaneto et al. 2009). This leaves just 75% of female physicians working 9 years after graduating (Ministry of Health, Labour and Welfare 2006). In addition,

the proportion of general female researchers in Japan was only 20% between 2011 and 2015, which was the lowest proportion among 12 targeted countries (Elsevier 2017). As for female physicians working in academia, men outnumbered women 8 to 1 among physicians employed as assistant professors or higher at one national medical school in Japan in 2013 (Okoshi et al. 2014). For both female physicians and female researchers, motherhood can be the most difficult obstacle in career development (Japan Medical Association 2009; Kaneto et al. 2009; Sawa and Tsumori 2010). In Japan, domestic responsibilities, and especially parental duties, are shouldered more by women, including female physicians, than by men (Tsukada et al. 2009). Moreover, female physicians may also maintain traditional gender roles at home. For example, one study reported that

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while approximately half of female surgeons in the U.S. and Hong Kong consider men and women as equals at home, only 25% of female surgeons in Japan consider themselves as equals, and 50% of them believe that men receive favorable treatment at home (Kawase et al. 2013). More specifically, they believe that women have to shoulder more responsibilities than men at home (Kawase et al. 2013). In Japanese culture, the roles of housewife and mother are highly valued (Hsia and Scabzibu 1996).

Besides these gender-related issues, a general shortage of physicians working in the basic sciences is also a critical problem to be fixed (Matsuo and Iki 2005). Working as a basic scientist, which usually requires both an MD and a PhD in Japan (Matsuo and Iki 2005), involves conducting clinical, academic, and translational research as well as teaching medical sciences. If there are few successors, basic research in Japan may collapse, as this field has chiefly been led by basic science physicians (Matsuo and Iki 2005). A previous questionnaire study suggested that one solution for encouraging more physicians to work in the basic sciences might be to attract female physicians by highlighting the appeal of flexible working hours (Yamazaki et al. 2012), given that basic science physicians reported being able to make their work fit their desired lifestyle to a reasonably good extent due to, for example, having no night duties, emergency cases, or irregular working hours. Moreover, an earlier study found that a good work-life balance was very important to Japanese female physicians as they wanted to be a good worker as well as a good mother (Yamazaki et al. 2010).

Our research efforts to help redress this shortage of basic scientists in Japan highlight three main issues affecting medical labor rates in Japan: early retirement of female physicians in general, fewer females than males working in research fields, and a general shortage of basic scientist physicians. We believe that working in the basic sciences could offer female physicians a good career path as a physician, help relieve the shortage of female researchers, and alleviate the general physician shortage in the basic sciences. However, few studies have examined the satisfaction of female physicians with basic science work, either in Japan or overseas. Therefore, in 2012, we conducted a questionnaire survey focusing on all female physicians employed as an assistant professor or higher in basic science departments at all 80 medical schools in Japan to investigate which aspects of their work led to professional advancement and personal fulfillment. The quantitative results have already been published and have revealed that although female basic science physicians with children tend to express second thoughts about relinquishing a full-time clinical practice, they generally benefited from better work flexibility, with no significant effect on career development and salary as basic scientists (Yamazaki et al. 2017). Among the questions asked, one qualitative question asked respondents to write down their thoughts on what positive aspects of their work in basic sciences were different from

working in clinical settings. The present study reports the findings of a qualitative analysis of the responses to this question, with the ultimate goal of using the positive aspects identified to attract young female physicians to enter a career path in the basic sciences. We also wanted to confirm whether the benefits of flexible working hours and no night duties reported in a previous study with male and female physicians in the basic sciences (Yamazaki et al. 2012) were found in the qualitative data obtained from female physicians in the present study.

Materials and Methods

Participants

Data were obtained in a cross-sectional survey conducted throughout October 2012. A questionnaire was mailed to all 228 female physicians with an academic rank of assistant professor or higher in basic science departments at all 80 medical schools in Japan. The reason we selected subjects with the academic rank of assistant professor or higher was that we wanted to obtain opinions from those female physicians who had already established their careers as basic scientist physicians. They were selected to receive a questionnaire from information stated on their university's website about their sex, degree, and academic rank. They were judged to be female by their first names. Basic sciences were defined according to the definition of the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) to be sciences that medical students must study, which includes anatomy, physiology, biochemistry, pathology, immunology, bacteriology, pharmacology, hygiene and environmental science, public health, and forensic medicine (MEXT, Ministry of Education, Culture, Sports, Science and Technology 2012). In addition to the government's criteria, we also considered departments identified as basic sciences based on each medical school's policy. As for the subjects' specialties, 36% worked in pathology, 21% in social medicine, and 10% in physiology at the time of the survey.

Data collection

The anonymous questionnaire was mailed to each participant's office, as indicated on their medical school's website in October 2012 and collected by mail within the same month. The questionnaire did not require subjects to disclose their personal information and they could choose to answer anonymously. The returned questionnaires were immediately labeled with an identification number and processed in a delinked anonymous manner. Reminder letters were sent to the participants 1 week before the deadline to improve the response rate.

This study received ethics approval from the Ethical Review Board of Juntendo University Faculty of Medicine (No. 2012099), Tokyo, Japan. The purpose of the study and the protection of personal information were explained in the face sheet of the questionnaire and we considered respondents as having consented to participate in this study if they returned the questionnaire to us by mail. The entire research conforms to the principles outlined in the Declaration of Helsinki.

Questionnaire contents

The 14-item questionnaire asked quantitative questions and one qualitative question. This study focuses on the responses received to

the qualitative question, an open-ended question asking respondents to provide their thoughts on positive aspects of working in the basic sciences, using space given in a free-form comments section. The actual question was: What are the positive aspects of working in the basic sciences that working in clinical medicine does not offer? This qualitative question was not a mandatory question, and subjects gave their comments voluntarily.

Analysis method

The free-form comments were analyzed qualitatively by hand using the Kawakita Jiro (KJ) method, which was developed as a tool for creating new ideas (Kawakita 1967). Several Japanese qualitative studies have used this KJ method for analysis (Yamazaki et al. 2010; Kaneko et al. 2015). Briefly, we placed the respondents' descriptions onto cards, where the description on each card had only one meaning. We spread all the cards on a table to group them semantically and named each of the groups formed according to the content, starting by making smaller groups and then grouping these together to make larger groups. The grouping process was completed when the minimum number of groups was reached. Next, we made structural drawings to obtain the spatial layout that best explained the logical interrelations between the largest groups, and lastly confirmed that the layout readily explained the content.

The analysis was done by A, B, and C to minimize bias and eliminate any preconceived notions that could result from a single author performing the analysis. A and C are female physicians and had prior experience of the KJ method; B is a male physician and had no experience of the method. A worked in a basic science department; B and C were practicing clinicians. The utmost attention was paid to the meaning of the descriptions, words, and terms used, and the analysis was deemed to be complete when a consensus was reached. D and E were not engaged in analysis directly but supervised it and commented on the structural drawing created. E is a male professor with a PhD who had knowledge of the KJ method, and D is a male professor with an MD and a PhD in basic science. The analysis was completed when all five authors were satisfied with the final structural drawing produced. Authors individually examined their own role in the research and possible bias resulting from demographic factors.

Results

The questionnaire was returned by 123 of the 228 female physicians (response rate 54.0%). Of these 123 respondents, 2 were not working full-time in a basic science department and 1 was a non-medical doctor. Of the remaining subjects, 58 provided a free-form comment to the qualitative question asked and these were analyzed in this study. Of these 58 subjects, 31 had children and the most common specialty ($n = 14$, 24%) was pathology.

The descriptions provided were divided into 300 fragments. For grouping, 15 small groups were generated first and were then connected to produce 14 medium-sized groups associated with positive and negative aspects of working in basic science. Finally, 6 large groups were produced: Advantages of Medical Knowledge, Limitations of Clinical Medicine, Career Advantages for Female Physicians, Good Qualities of the Basic Sciences, Bad Qualities of the Basic Sciences, and Career Disadvantages

for Female Physicians. We presented the groups in diagrammatic form, shown in Fig. 1.

Below, we present the relations between the “good” and “bad” qualities of the basic sciences and then between each of these two main groups and other factors affecting them. The main groups are shown in square brackets, the factors identified within them in curly brackets, and the sub-factors within those in parentheses.

Good qualities of the basic sciences

[Good Qualities of the Basic Sciences] were divided into 4 main groups, {Attractiveness of Basic Science Research}, {Healthy Work-Life Balance}, {Priority on Research Productivity}, and {No Patients}. {Attractiveness of Basic Science Research} such as (an exciting life with new discoveries and exploration of the unknown) and (obtaining knowledge beyond textbooks about diseases) dominated [Good Qualities of the Basic Sciences]. In addition, {Advantages of Medical Knowledge} such as (physicians can fulfill their potential in translational research) and (physicians can do research directly linked to clinical medicine) and {Limitations of Clinical Medicine} such as (without the development of fundamental basic science research, clinical medicine will not evolve) increased the {Attractiveness of Basic Science Research}. The nature of basic science work, such as {Priority on Research Productivity} and {No Patients}, where physicians were free from (night shifts) and (clinical duties), contributed to a {Healthy Work-Life Balance}, such as (physicians can control work pace, workload, and work style).

Finally, [Career Advantages for Female Physicians] were divided into 2 main groups, {Absence of Gender Segregation} and {Enough Time for Parental Duties}. {Priority on Research Productivity} in an environment where (research productivity is the most important evaluation criterion) alleviated {Gender Segregation} because (female physicians can be promoted as long as they publish many academic papers and attract grant money). Also, a {Healthy Work-Life Balance} gave female physicians {Enough Time for Parental Duties}, for example, (managing child-rearing and work because they control their work schedule and workload).

Bad qualities of the basic sciences

[Bad Qualities of the Basic Sciences] were divided into 4 main groups, {Tough Competition}, {Unexpected Overtime}, {Disadvantages of Absence of Patient Caseload}, which involved (salary issues) and (lack of motivation), and {Labor Shortage}. {Priority on Research Productivity} in [Good Qualities of the Basic Sciences] resulted in the bad quality of {Tough Competition}, such as (if you are not interested in research, you may lose) or (basic sciences have fewer posts than clinical medicine). Moreover, this {Tough Competition} led to {Unexpected Overtime} such as (productivity depends on the amount of time that I can devote to research). {Disadvantages of Absence of Patient

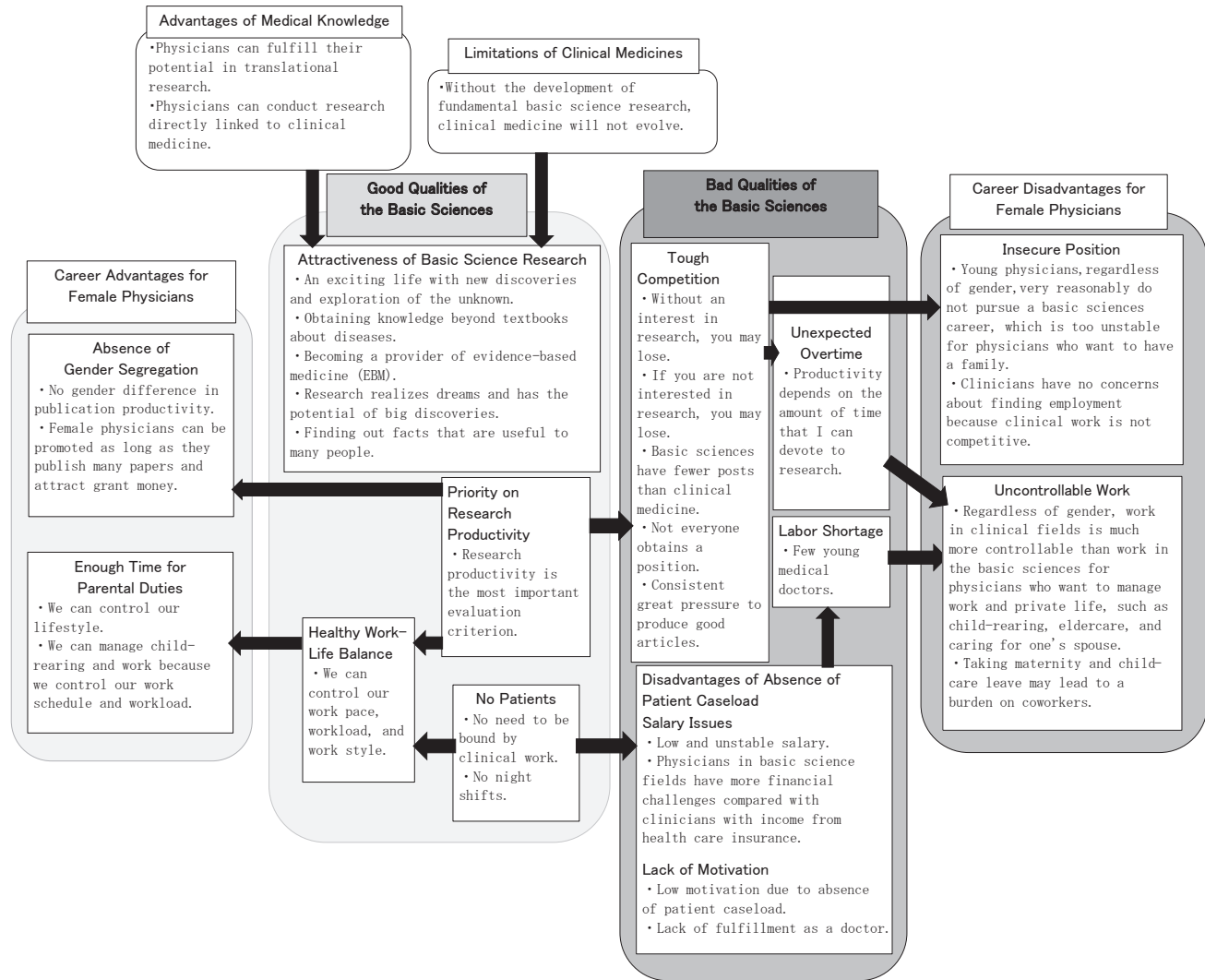


Fig. 1. “Good” and “bad” qualities of the basic sciences reported by female basic science physicians.

Caseload} were divided into 2 main groups, (salary issues) and (lack of motivation). Without patients, (physicians in basic science fields have more financial challenges compared with clinicians with income from health care insurance) and physicians have (low motivation due to the absence of patient caseload). Due to these disadvantages of not seeing patients, young physicians did not enter the basic sciences and this led to a {Labor Shortage}.

Finally, [Career Disadvantages for Female Physicians] were divided into {Insecure Position} and {Uncontrollable Work}. {Tough Competition} created an {Insecure Position} such as (young physicians, regardless of gender, very reasonably do not pursue a career in basic sciences because such a career is too unstable for young physicians who want to have family). In addition, {Unexpected Overtime} and a {Labor Shortage} led to an {Uncontrollable Work} environment, such as (regardless of gender, work in clinical fields is much more controllable than work in the basic sciences for physician who want to manage work and private life, such as child-rearing, eldercare, and caring for one's

spouse) and (taking maternity and child-care leave may burden coworkers).

Discussion

We found that {Attractiveness of Basic Science Research} was the most appealing factor for female physicians to work in the basic sciences. Other positive factors such as {Priority on Research Productivity} and {No Patients} were, however, double edged-swords for female physicians to retain a {Healthy Work-Life Balance}. Therefore, using the phrase “good work-life balance” to attract female students or physicians to basic science departments may be problematic.

A spirit of academic inquiry in basic science research may be the greatest factor driving physicians, regardless of gender, to the research world. Our finding concurs with that of one previous study on college undergraduates that predicted persistence into PhD and MD/PhD training at the Mayo Clinic College of Medicine (McGee and Keller 2007): the most common reason that students entered these

training programs was curiosity to discover the unknown. Fifteen of the 18 students who went on to start their research career in the basic sciences expressed a strong curiosity for finding out something new that had never been known or discovered before (McGee and Keller 2007). The results of the present study also support the findings in our previous studies in Japan in which medical students mentioned that attempting unknown things was a major point of the basic sciences (Yamazaki et al. 2013) and research interest was the primary motivation to choose a career in basic sciences for female physicians (Yamazaki et al. 2017). In the present study, participants also mentioned the {Attractiveness of Basic Science Research} using phrases such as (an exciting life with new discoveries and exploration of the unknown), (obtaining knowledge beyond textbooks about diseases), (becoming a provider of evidence-based medicine), and (finding out facts that are useful to many people). In addition, their learning as physicians such as [Advantages of Medical Knowledge] and their awareness in the clinical setting such as [Limitation of Clinical Medicine] boosted the {Attractiveness of Basic Science Research}. This finding supports those mentioned above in the previous study by Yamazaki et al. (2013) in which medical students who had already completed bedside learning were more likely to be interested in the basic sciences than medical students who had not yet started bedside learning. Students with clinical training commented, “I realized the importance of the basic sciences through bedside learning” and “basic sciences contribute to advances in medicine” (Yamazaki et al. 2013). Thus, clinical experience might increase the interests of physicians in the basic sciences. This supports the finding of a previous study that advanced medical students tended to support the notion that knowledge of biological mechanisms was important more than younger medical students did and that the advanced students were more excited by faculty’s teaching of the basic sciences (Custers and Cate 2002). Our finding also concurs with that of an Australian study involving intensive care residents where the number of participants who became involved in basic science research increased during training (Laurie et al. 2008). One explanation for this is that seeing patients, learning about disease, and identifying etiologies of disorders might encourage medical doctors to recognize the importance of, and excitement inherent to, the basic sciences (Ohtsuka and Shimizu 2012). For these reasons, in terms of medical and clinical knowledge, medical doctors may be able to enjoy the essence of the basic sciences and anticipate how the outcomes of basic science research can be applied to promote well-being.

{Priority on Research Productivity} may alleviate {Gender Segregation} in the academic setting. Given that publication productivity is an important career marker for advancement in academic settings (Davidoff 1998; Custers and Cate 2002; Abdulmajeed et al. 2014), those who publish high-quality research regularly can expect to be promoted regardless of their sex (i.e., the glass ceiling effect)

or parental status. Also, if researchers can achieve their quota, they tend to control their work schedule. So, this can help them maintain a {Healthy Work-Life Balance} to some extent. Conversely, in clinical settings generally in Japan, the glass ceiling still exists and it may discourage some female physicians (Nomura and Gohchi 2012). Working in basic science fields may then offer talented female physicians a less constrained way to fulfill their research potential. At the same time, however, {Priority on Research Productivity} often creates {Tough Competition}. The already limited number of faculty positions has recently started to decline (Maeda et al. 2009). Thus, to work in research/academia, researchers must publish a certain number of papers regularly to maintain good productivity. Under such circumstances, our respondents reported that the researcher may not be able to do this without sufficient research ability. Moreover, to maintain good productivity, researchers must devote considerable time to their research. For instance, {Unexpected Overtime} is sometimes necessary because (productivity depends on the amount of time they can devote to research). Also, {Tough Competition} could lead to an {Insecure Position}, and a number of respondents reported that (clinicians more easily find jobs than physicians in basic science fields). In fact, Maeda et al. (2009) stated that the problem concerns a limited number of research posts in general. Therefore, physicians who want a secure and more predictable future choose the clinical path (McGee and Keller 2007).

{No Patients} enabled physicians to control their work. Exemption from clinical duties, in particular, may contribute greatly to a {Healthy Work-Life Balance}. Thus, female physicians in the basic sciences had somewhat greater control over their work-life balance, with a negligible effect on career advancement, as a previous study implied (Yamazaki et al. 2012). Also, they may then have more time to spend on parental duties. Given that both professional fulfillment and responsibility for family life demand physical, emotional, and social resources, together these factors can help with a well-balanced lifestyle, which creates positive energy and which, in turn, can be an important motivator for females to continue their careers (Schueller-Weidekamm and Kautzky-Willer 2012). However, both {No Patients} and {Priority on Research Productivity} also lead to [Bad Qualities of the Basic Sciences], which can reduce the motivation of female physicians to continue working as basic scientists for the following reasons. The negative aspect of working without seeing patients may contribute to the physician shortage in basic science fields. Most physicians entered medical school because they wanted to work directly with patients (Yamazaki et al. 2012, 2013), so a basic science position where they do not see patients may lower their motivation to continue working in the basic sciences. This concurs with a previous finding that one negative aspect of working in basic science is the dimming awareness of being a physician (Yamazaki et al. 2012). Also, the survey conducted by

Mayo Clinic College of Medicine reported that even students with strong research interests can choose medical school because of their strong motivation to help patients directly (McGee and Keller 2007). On a related issue, because physicians in basic science departments do not see patients, they cannot derive income through health insurance payments. Sometimes then the income of physicians in the basic sciences is lower than that of clinicians, and low income was found to be the main barrier for medical students entering basic science fields in Japan (Yamazaki et al. 2012, 2013). For these reasons, the {Labor Shortage} has worsened in basic science departments. Some respondents in the present study stated that, ultimately, working in the basic sciences is less controllable than working in clinical medicine due to {Tough Competition} and the {Labor Shortage}, so this may lead to them thinking that female clinicians can more easily perform parental duties than physicians in the basic sciences. To maintain a certain number of publications may also be a challenge for female physicians with parental duties. Even in Stanford University Medical Center, female faculty produce fewer publications than their male counterparts, and women leave academia at a higher rate because of family and other obligations (Mueller et al. 2016).

As mentioned above, {Priority on Research Productivity} and {No Patients} are sometimes favorable factors for female physicians to continue working, but they can also become negative factors. Although our prior study implied that basic science may be a good career path for female physicians (Yamazaki et al. 2012), a {Healthy Work-Life Balance} is not always guaranteed in basic science fields. Instead, the {Attractiveness of Basic Science Research} is a consistent as well as most advantageous factor for working in basic science, implying that only physicians with research curiosity can be excited enough to work on cutting-edge research, which in turn motivates them to overcome {Tough Competition} regardless of their sex, parental duties, or family obligations. Taken together with the fact that physicians without sufficient research interest will likely drop out of research, our findings suggest that focusing on a {Healthy Work-Life Balance} to appeal to female medical students is not the best solution to recruit them to the basic sciences. Recently, regardless of gender, a controllable lifestyle is becoming a crucial factor for medical students when choosing a specialty (Kawamoto et al. 2016). In addition, female medical students in particular choose a specialty based on the possibility of marriage and childbirth (Takahashi et al. 2017). However, from the present results, we question the impact of work-life balance on career decisions. Without an intrinsic interest in the target specialty, physicians may not be motivated to continue working in that specialty. Therefore, for the basic sciences, recruitment of young physicians should involve lectures and practical training that stimulates medical students' interest in the basic sciences because the thrill of discovery is the basis for career decision-making of many scientists (McGee and

Keller 2007). In addition, gender, race, ethnicity, or social status may affect physicians' specialty choices (Pamies et al. 1994; Lambert et al. 2014; Boekeloo et al. 2015). Yet, regardless of these extrinsic barriers, medical educators should make efforts to respect the interest in and curiosity of young students when they are deciding on their careers (Boekeloo et al. 2015) and they should create an academic environment in which extrinsic barriers do not skew students' intrinsic motivation. Intrinsic motivation for career decisions is crucial for doctors' long-term careers (Boekeloo et al. 2015).

This study has several limitations. First, as this was a qualitative study, further studies, including quantitative ones, are needed to more comprehensively ascertain the good aspects of basic sciences. Second, this research was conducted in Japan, which has its own medical educational system and health policy, and the results should not be generalized globally. Third, the response rate of this study was not particularly high (54.0 %), with only 58 of the total 228 survey respondents (25.4%) providing an open comment. Several factors contributed to this response rate. First, some male physicians and female non-physician researchers might have mistakenly received questionnaires; however, we tried to minimize their response because the survey instructions indicated that the survey did not pertain to them. Second, medical school websites are not always regularly updated and therefore questionnaires could have been sent to subjects who no longer worked there. Third, the overall response rate to the survey was not high, at 54.0%, probably because physicians tend to be extremely busy (Yamazaki and Marui 2009). However, it is still significantly higher than a previous Japanese study on female physicians, with a total response rate of 38.2% (Yamazaki and Marui 2009). Moreover, in terms of the small proportion (25.4%) of respondents who provided the free comment analyzed in this study, the voluntary nature of the question might not have encouraged them to answer the question, but the rate was still higher than the 3.7% response rate in another qualitative study focusing on female physicians (Nomura et al. 2015). Thus, the response rate of the present study did not appear to weaken the quality of the study. Fourth, this study focused on female physicians' opinions about qualities of the basic sciences. However, male physicians might have different opinions. Therefore, to obtain the truest picture of the good points of basic sciences, male physicians' opinions should also be considered. Finally, as all participants were working as an assistant professor or higher in basic sciences fields, they were career survivors who were managing their work and private life. We were not able to gather responses from female physicians who left academia.

Conclusions

We found that the main positive aspects of working in the basic sciences are attractiveness of basic science research, a healthy work-life balance, priority of research

productivity, and having no patients. Among these, the most appealing aspect was attractiveness of basic science research. Generally, Japanese female physicians may seek a good work-life balance in order to meet traditional gender roles. In addition, our prior study implies that the flexible working style in basic science fields may better suit the parental duties of female physicians, and the present study also suggests that a good work-life balance is one of the favorable aspects of the basic sciences. However, those who seek only a good work-life balance may not survive in competitive and insecure research fields due to the high research productivity that is expected. Thus, as recruitment strategies targeting medical students, medical educators should promote students' interest in research through lectures, practical training, and mentorship, as well as discuss with them the positive aspects of working in basic science, including work-life balance. As global implications of present results, in order to attract and retain physicians in specialties with physician shortages, it is important to create an academic environment where culture, gender, race, ethnicity, and social background do not skew students' intrinsic interest in a specific area.

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Conflict of Interest

The authors declare no conflict of interest.

References

- Abdulmajeed, A.A., Ismail, M.A. & Nour-Eldein, H. (2014) Research publications in medical journals (1992-2013) by family medicine authors - Suez Canal University-Egypt. *J. Family Med. Prim. Care*, **3**, 368-373.
- Boekeloo, B.O., Jones, C., Bhagat, K., Siddiqui, J. & Wang, M.Q. (2015) The role of intrinsic motivation in the pursuit of health science-related careers among youth from underrepresented low socioeconomic populations. *J. Urban Health*, **92**, 980-994.
- Custers, E.J. & Cate, O.T. (2002) Medical students' attitudes towards and perception of the basic sciences: a comparison between students in the old and the new curriculum at the University Medical Center Utrecht, The Netherlands. *Med. Educ.*, **36**, 1142-1150.
- Davidoff, F. (1998) Publication and promotion. *Intelligence work. Lancet*, **352**, 895-896.
- Elsevier (2017) Gender in the global research landscape. https://www.elsevier.com/_data/assets/pdf_file/0008/265661/ElsevierGenderReport_final_for-web.pdf [Accessed: August 09, 2017].
- Hsia, H.C. & Scabzibu, J.H. (1996) Rethinking the role of Japanese women. *Journal of Comparative Family Studies*, **27**, 309-329.
- Japan Medical Association (2009) Report of the current situation of work environment for female physicians, March 2009. http://dl.med.or.jp/dl-med/teireikaiken/20090408_2.pdf [Accessed: January 23, 2017].
- Kaneko, M., Ohashi, H., Takamura, T. & Kawame, H. (2015) Psychosocial responses to being identified as a balanced chromosomal translocation carrier: a qualitative investigation of parents in Japan. *J. Genet. Couns.*, **24**, 922-930.
- Kaneto, C., Toyokawa, S., Inoue, K. & Kobayashi, Y. (2009) Gender difference in physician workforce participation in Japan. *Health Policy*, **89**, 115-123.
- Kawakita, J. (1967) *The Way of Thinking for Creative Development*, Chuukousinnsyo, Tokyo.
- Kawamoto, R., Ninomiya, D., Kasai, Y., Kusunoki, T., Ohtsuka, N., Kumagi, T. & Abe, M. (2016) Gender difference in preference of specialty as a career choice among Japanese medical students. *BMC Med. Educ.*, **16**, 288.
- Kawase, K., Kwong, A., Yorozyu, K., Tomizawa, Y., Numann, P.J. & Sanfey, H. (2013) The attitude and perceptions of work-life balance: a comparison among women surgeons in Japan, USA, and Hong Kong China. *World J. Surg.*, **37**, 2-11.
- Lambert, T., Surman, G. & Goldacre, M. (2014) UK doctors and equal opportunities in the NHS: national questionnaire surveys of views on gender, ethnicity and disability. *J. R. Soc. Med.*, **107**, 398-408.
- Laurie, G.A., Venkatesh, B., Kruger, P.S., Morgan, T.J. & Pascoe, R.L. (2008) Basic science research in Australian intensive care practice. *Crit. Care Resusc.*, **10**, 52.
- Maeda, M., Okabe, S., Shibata, Y. & Okabe, Y. (2009) The results of a questionnaire survey conducted by the Japanese Association of Anatomists and the Physiological Society of Japan about Education and Research in Basic Science. *Nihon Seirigaku Zasshi*, **71**, 81-132.
- Matsuo, O. & Iki, M. (2005) Course to researcher in basic medicine. *Igaku Kyouiku*, **36**, 301-303.
- McGee, R. & Keller, J.L. (2007) Identifying future scientists: predicting persistence into research training. *CBE Life Sci. Educ.*, **6**, 316-331.
- Ministry of Health, Labour and Welfare (2006) Interim report from the study committee on physician supply and demand, 8 February 2006. <http://www.mhlw.go.jp/shingi/2006/02/s0208-12c.html> [Accessed: August 09, 2017].
- Ministry of Health, Labour and Welfare of Japan (1985) *Surveys of Physicians, Dentists, and Pharmacists 1984*, 1st ed, Ministry of Health, Labour and Welfare of Japan, Tokyo.
- Ministry of Health, Labour and Welfare, Tokyo Ministry of Health, Labour, and Welfare (2015) Surveys of physicians, dentists, and pharmacists 2014. http://www.mhlw.go.jp/toukei/saiken/hw/ishi/14/dl/kekka_1.pdf [Accessed: August 09, 2017].
- Ministry of Education, Culture, Sports, Science and Technology (MEXT) (2012) Developing basic sciences physicians who engaged in the basis of sophistication of medicine and health care, April 2012. http://www.mext.go.jp/component/a_menu/education/detail/_icsFiles/afildfile/2013/04/04/1333004_1.pdf [Accessed: August 09, 2017].
- Mueller, C.M., Gaudilliere, D.K., Kin, C., Menorca, R. & Girod, S. (2016) Gender disparities in scholarly productivity of US academic surgeons. *J. Surg. Res.*, **203**, 28-33.
- Nomura, K. & Gohchi, K. (2012) Impact of gender-based career obstacles on the working status of women physicians in Japan. *Soc. Sci. Med.*, **75**, 1612-1616.
- Nomura, K., Yamazaki, Y., Gruppen, L.D., Horie, S., Takeuchi, M. & Illing, J. (2015) The difficulty of professional continuation among female doctors in Japan: a qualitative study of alumnae of 13 medical schools in Japan. *BMJ Open*, **5**, e005845.
- Ohtsuka, Y. & Shimizu, T. (2012) Career path for physician scientists: what should constitute the clinical training and development of basic or clinical researchers in doctoral programs. *Juntendo Igaku*, **58**, 32-35.
- Okoshi, K., Nomura, K., Fukami, K., Tomizawa, Y., Kobayashi, K.,

- Kinoshita, K. & Sakai, Y. (2014) Gender inequality in career advancement for females in Japanese academic surgery. *Tohoku J. Exp. Med.*, **234**, 221-227.
- Pamies, R.J., Lawrence, L.E., Helm, E.G. & Strayhorn, G. (1994) The effects of certain student and institutional characteristics on minority medical student specialty choice. *J. Natl. Med. Assoc.*, **86**, 136-140.
- Sawa, A. & Tsumori, T. (2010) Comprehensive support plan for woman researchers and medical doctors at Shimane University. *Igaku No Ayumi*, **234**, 173-181.
- Schueller-Weidekamm, C. & Kautzky-Willer, A. (2012) Challenges of work-life balance for women physicians/mothers working in leadership positions. *Gend. Med.*, **9**, 244-250.
- Takahashi, K., Nin, T., Akano, M., Hasuike, Y., Iijima, H. & Suzuki, K. (2017) Views of Japanese medical students on the work-life balance of female physicians. *Int. J. Med. Educ.*, **8**, 165-169.
- Tsukada, Y.T., Tokita, M., Kato, K., Kato, Y., Miyauchi, M., Ono, I., Tanabe, H., Yokoshima, T., Fukumoto, H., Miyatake, Y. & Mizuno, K. (2009) Solutions for retention of female cardiologists: from the survey of gender differences in the work and life of cardiologists. *Circ. J.*, **73**, 2076-2083.
- Yamazaki, Y., Horiguchi, I. & Marui, E. (2010) Comparison of turnover issues among female physicians by generation: a qualitative study focusing on alumnae of Juntendo University. *Igaku Kyouiku*, **41**, 411-416.
- Yamazaki, Y. & Marui, E. (2009) An alumna survey of female physicians. *Juntendo Igaku*, **55**, 142-147.
- Yamazaki, Y., Uka, T. & Marui, E. (2017) Professional fulfillment and parenting work-life balance in female physicians in basic Sciences and medical research: a nationwide cross-sectional survey of all 80 medical schools in Japan. *Hum. Resour. Health*, **15**, 65.
- Yamazaki, Y., Uka, T., Shimizu, H., Miyahira, A., Sakai, T. & Marui, E. (2012) Characteristics of physicians engaged in basic sciences: a questionnaire survey of physicians in basic sciences departments of a medical school in Japan. *Tohoku J. Exp. Med.*, **228**, 75-82.
- Yamazaki, Y., Uka, T., Shimizu, H., Miyahira, A., Sakai, T. & Marui, E. (2013) Japanese medical students' interest in basic sciences: a questionnaire survey of a medical school in Japan. *Tohoku J. Exp. Med.*, **229**, 129-136.
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