

Preventive behaviours against radiation and related factors among general workers after Fukushima's nuclear disasters

Hideyuki Kanda,^{1,2} Takehito Hayakawa,¹ Kikuo Koyama²

¹Department of Hygiene and Preventive Medicine, Fukushima Medical University, Fukushima, Japan

²Fukushima Occupational Health Promotion Center, Fukushima, Japan

Correspondence to

Dr Hideyuki Kanda, Department of Hygiene and Preventive Medicine, Fukushima Medical University, Hikarigaoka 1, Fukushima 920-1295, Japan; hkanda@fmu.ac.jp

Accepted 31 March 2012

ABSTRACT

Background The nuclear power plant accidents in Fukushima resulted in a widespread release of radioactive substances in the Fukushima prefecture.

Aim To clarify what factors led to precautions among general workers who displayed preventive behaviours against radiation following the nuclear disasters in Fukushima.

Methods Descriptive study of preventive behaviours among general workers 3–5 months following the nuclear disasters. The subjects were 1394 regular workers who took part in radiation seminars conducted by the Fukushima Occupational Health Promotion Center between July and August 2011. Of 1217 responses, 1110 eligible responses were included in this study. This anonymous questionnaire survey was asking for characteristics and questions on preventive behaviours following the nuclear disasters. The authors assessed the contribution of each variable by a logistic regression analysis.

Results Keeping track of environmental radiation levels and washing hands and gargling were significantly more frequent among female subjects, older age and workers residing up to approximately 80 km away from the power plants. Washing hands and gargling were also related with living with children. Wearing a mask when leaving home and buying bottled water were significantly more often observed with female subjects and workers residing up to 80 km. Refraining from going outdoors was positively associated with workers residing up to 80 km and workers living with children.

Conclusions These results provide information that may help with the targeting of health information after a nuclear disaster. This may contribute to determining an order of priority when distributing information after a nuclear disaster.

INTRODUCTION

Many people living in Fukushima are concerned about radiation levels in their areas. The Fukushima Dai-ichi nuclear power plants (FDNPP), operated by the Tokyo Electric Power Company, suffered major damage from the magnitude 9.0 earthquake and subsequent tsunamis that hit Eastern Japan on 11 March 2011.^{1 2} The earthquakes and tsunamis disabled the reactor's cooling systems,^{2 3} which led to a hydrogen explosion at the No. 1 building of the FDNPP on 12 March 2011, and a second hydrogen explosion at the No. 3 building on 14 March 2011. The pressure valves of the nuclear reactor containment vessel at the No. 2 building were opened on 13 March 2011. These accidents resulted in the release of radioactive substances from the FDNPP,³ and triggered the Japanese government to implement

a 20 km evacuation zone surrounding them. The radiation pollution has now contaminated areas throughout Fukushima prefecture and various parts of Eastern Japan as well.⁴ Both the Nuclear and Industrial Safety Agency, which is one of the government organisations, and the Fukushima prefectural government showed information calling for nuclear attention such as refraining from going outside, rigorous enforcement of washing hands and gargling, brushing dirt off clothing after returning home, and wearing a mask when leaving home soon after the nuclear accidents.^{5 6} There had been public information broadcasting suggesting these preventive behaviours against radiation at that time.

According to the Fukushima prefectural government, as of 22 August 2011, over 50 000 citizens have evacuated from Fukushima to other prefectures since 11 March 2011.⁷ Many of those affected by the natural and nuclear disasters have been forced to live as evacuees, having lost their homes due to earthquake and tsunami damage, or from living within the 20 km evacuation zone. In addition, as a result of these nuclear plant accidents, many households with children have taken voluntary refuge at other prefectures due to concerns of radiation and its effects on the health of their children.⁸ Many of the households taking voluntary refuge have one or two household members that are in their prime working years, meaning an outflow of skilled labour to other prefectures has been unavoidable.⁹ On the other hand, workers who are staying in Fukushima have been forced to cope with issues related to radiation exposure. In an attempt to minimise their exposure, workers in Fukushima have been displaying preventive behaviours against radiation, such as wearing masks and refraining from going outside. However, no studies have been done so far on what factors are influencing workers while they are deciding to take preventive actions.

This present study attempts to clarify what factors influenced workers in Fukushima when deciding on a preventive behaviour to take against radiation. Our aim is to contribute to a better understanding of the types of factors that associate with individuals making decisions on such behaviours against radiation when following a nuclear accident.

METHODS

Subjects

This study design was a cross-sectional questionnaire survey conducted among regular workers, 3–5 months following the nuclear disasters in Fukushima. The Fukushima Occupational Health

Promotion Center (FOHPC) serves as an active base for promoting occupational health activities within the Fukushima prefecture. One of the roles of the centre is to provide assistance to workers and to industrial health nurses and health supervisors. After the nuclear incidents, the FOHPC informed about holding the seminars against radiation on their website and through a pamphlet from May to August, 2011. The lectures on radiation and health were either hosted by or conducted under the joint auspices of the FOHPC between June and August, 2011. The reason why the seminars were delayed until 3–5 months after the nuclear incidents is because it took until July 2011 for the Japanese government and Tokyo Electric Power Company to announce the company had completed the initial stages of its restoration efforts at the Fukushima nuclear power plants, ensuring that the nuclear reactors were in fact being cooled and emissions of radiation substances were on the decline. The seminar for each participant was just one time from 60 min to 90 min. The content was as follows: a summary of the Fukushima nuclear power plant accident, the difference between radioactive activity and radiation, the kind of radioactive activity and radiation and the effects on the human body due to radiation (probabilistic effects and non-stochastic effects). In total, 41 seminars were held, and 1394 workers were given information on radiation and health. The subjects of our study were participants who took part in one or more of these radiation seminars. All participants gave informed consent to release information for the study. This study was reviewed and approved by the FOHPC.

Outcomes

The study was conducted by distributing anonymous questionnaires to all subjects and collecting them prior to the start of each

seminar. There were two parts to the questionnaire: the first asked for biographical and background information such as gender, age category, and questions asking whether they evacuated, whether they are living with someone who is pregnant, whether they are living with children or teenagers, what industry they work in, and in what area of Fukushima they reside currently. The residential areas in the questionnaire were divided into four areas: 'coastal areas', up to approximately 40 km away from the FDNPP and excluding the evacuation zone; 'central area', approximately 40–80 km away from the FDNPP; 'mountainous area', approximately 80 km and furthest away from the FDNPP; and 'other prefecture' (figure 1). The second part of the questionnaire asked subjects about the types of preventive behaviours they practiced following the nuclear disasters. A list of 10 preventive behaviours, namely, keeping track of environmental radiation levels using news sources such as newspapers, washing hands and gargling every day, wearing a mask when leaving home, buying bottled water, refraining from going outside, not buying agricultural products made in Fukushima, brushing dirt off clothing after returning home, spending more time in areas with lower doses of radiation within Fukushima, evacuating family members to low radiation areas, and spending more time in prefectures outside of Fukushima, was given to subjects who were then asked to select all of the behaviours they had taken following the nuclear accidents. Upon completion of the survey, the questionnaires were collected by workers at the FOHPC. Of 1217 responses, 107 responses did not have all the data needed for analysis, leaving 1110 eligible responses in the study.

Statistical analysis

A χ^2 test was used to compare frequencies between subjects who practiced preventive behaviours and subjects who did not.

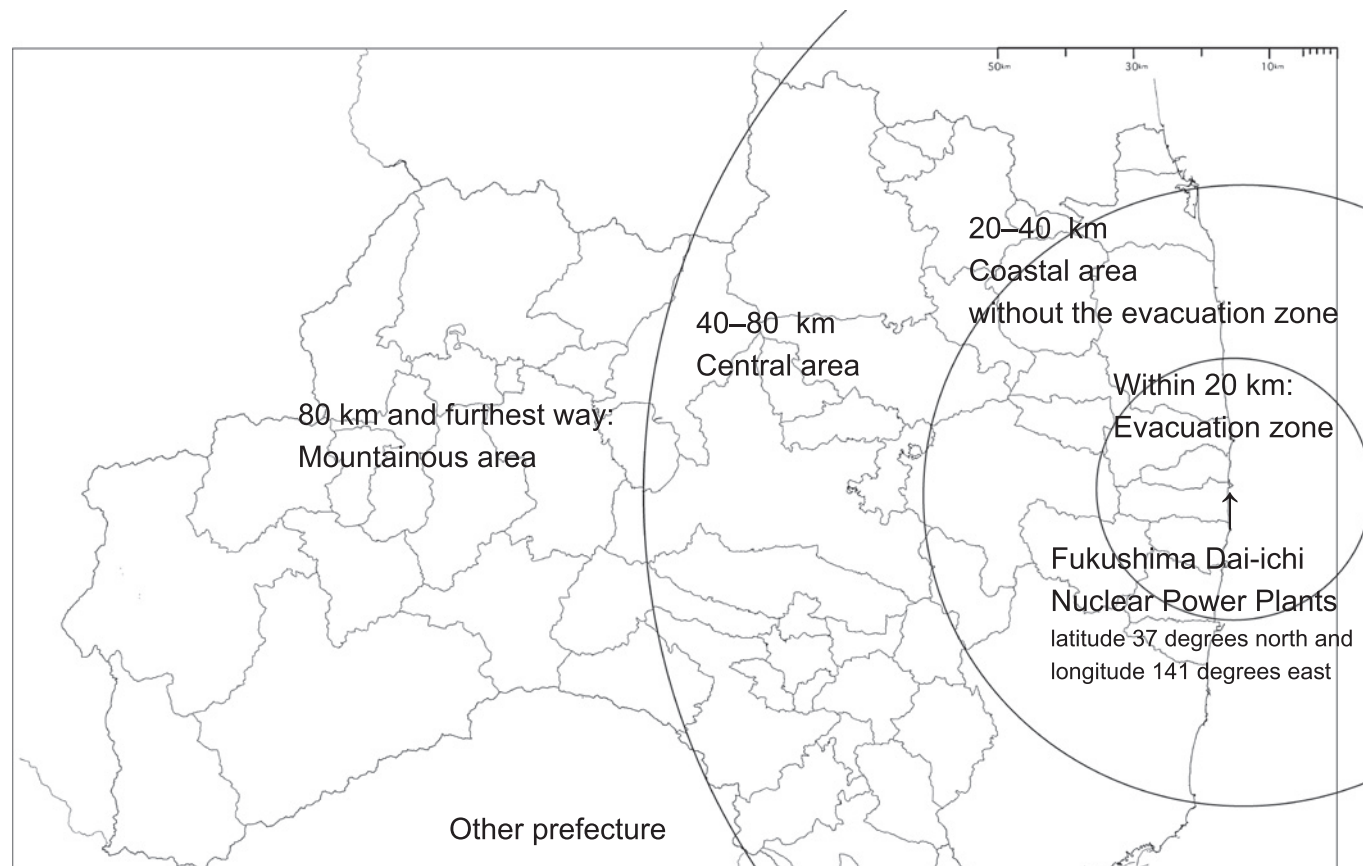


Figure 1 Residential areas from the Fukushima Dai-ichi nuclear power plants.

A multiple logistic regression analysis was used to assess the contribution of each biographical variable to the five most common preventive actions over 25% in frequency. The significance of the interaction of gender with other factors related to characteristics was tested using interaction term in multivariate models in the gender-combined analysis. The Statistical Package for the Social Sciences (SPSS Japan Inc. V.16.0J) was used for the analyses. All probability values were two-tailed and at a 5% level of significance.

RESULTS

Table 1 shows the characteristics of 917 workers who displayed preventive behaviours against radiation and 193 workers who did not. When using a χ^2 test, it was found that among those who displayed preventive behaviours against radiation, female workers and workers residing in coastal and central areas more often displayed preventive behaviours than others. On the other hand, workers in the building industries displayed less preventive behaviours than others.

Table 1 also shows a prevalence of certain preventive behaviours among 917 workers who acted against radiation following

the nuclear disasters in Fukushima. Workers who showed such behaviours selected an average of 2.3 (SD \pm 2.0) preventive behaviours each. The highest prevalence of preventive behaviours was 72.2%, which was keeping track of environmental radiation levels using sources such as newspapers.

Table 2 shows an OR and 95% CI of the five most commonly displayed preventive behaviours as determined using a logistic regression analysis. Keeping track of radiation levels was statistically significant with female workers, workers belonging to older age categories, and residents of central and coastal areas. Washing hands and gargling were positively related with female workers, older age categories, residents in central and coastal areas, and workers living with children or teenagers. Wearing a mask when leaving home and buying bottled water were significantly more observed among female workers and residents in central and coastal areas. Refraining from going outside was positively associated with workers residing in central and coastal areas, and workers living with children or teenagers. Then, the interaction term of gender with other factors related to characteristics in multivariate models did not have statistical significance.

Table 1 Characteristics of 917 workers who took preventive measures against radiation and 193 workers who did not following Fukushima's nuclear disasters

	Workers who took preventive behaviours (N=917)	Workers who did not take preventive behaviours (N=193)	p Values*
Female workers (number, %)	266 (29.0%)	23 (11.9%)	<0.01
Age category (number, %)			
<30	84 (9.1%)	20 (10.3%)	0.95
30–39	186 (20.3%)	37 (19.2%)	
40–49	264 (28.8%)	55 (28.5%)	
50–59	289 (31.5%)	61 (31.6%)	
60 over	94 (10.2%)	20 (10.4%)	
Workers who evacuated (number, %)			
Government-ordered	11 (1.2%)	1 (0.5%)	0.67
Voluntary	6 (0.7%)	0 (0.0%)	
Workers living with a pregnant woman (number, %)	19 (2.1%)	2 (1.1%)	0.35
Workers living with children or teenagers (number, %)	418 (45.6%)	74 (38.3%)	0.07
Industry of profession (number, %)			
Building industry	155 (16.9%)	43 (22.3%)	0.04
Manufacturing industry	393 (42.9%)	90 (46.6%)	
Others	369 (40.2%)	60 (31.1%)	
Area of current residence in Fukushima prefecture (number, %)			
Coastal area without the evacuation zone	185 (20.2%)	13 (6.7%)	<0.01
Central area	616 (67.2%)	117 (60.6%)	
Mountainous area	90 (9.8%)	51 (26.4%)	
Other prefectures	26 (2.8%)	12 (6.2%)	
Number of preventive behaviours			
Number of preventive behaviours displayed (Mean \pm SD)	2.3 \pm 2.0		
Types of preventive behaviours			
Keeping track of environmental radiation levels through sources such as newspapers (number, %)	662 (72.2%)		
Rigorous enforcement of washing hands and gargling (number, %)	379 (41.3%)		
Wearing a mask when leaving home (number, %)	354 (38.6%)		
Buying bottled water (number, %)	293 (32.0%)		
Refraining from going outside (number, %)	255 (27.8%)		
Not buying agricultural products made in Fukushima (number, %)	154 (16.8%)		
Brushing dirt off clothing after returning home (number, %)	144 (15.7%)		
Spending more time in areas with lower doses of radiation within Fukushima (number, %)	129 (14.1%)		
Evacuating family members to lower radiation areas (number, %)	104 (11.3%)		
Spending more time in prefectures outside of Fukushima (number, %)	98 (10.7%)		

*p Values for χ^2 test.

Table 2 OR and 95% CIs for each of the common behaviours following Fukushima's nuclear disaster

	Keeping track of environmental radiation levels in the newspapers, etc OR (95% CI)	Rigorous enforcement of washing hands and gargling OR (95% CI)	Wearing a mask when leaving home OR (95% CI)	Buying bottled water OR (95% CI)	Refraining from going outside OR (95% CI)
Gender (0=man, 1=woman)	1.67 (1.23 to 2.25)	1.77 (1.31 to 2.39)	1.59 (1.18 to 2.16)	1.85 (1.35 to 2.55)	1.19 (0.85 to 1.66)
Age category (+10 years)	1.39 (1.24 to 1.56)	1.21 (1.08 to 1.37)	0.99 (0.88 to 1.12)	0.92 (0.81 to 1.04)	1.06 (0.93 to 1.22)
Living with a pregnant woman (0=no, 1=yes)	1.13 (0.46 to 2.80)	0.55 (0.22 to 1.39)	0.71 (0.28 to 1.78)	0.41 (0.16 to 1.05)	0.51 (0.20 to 1.31)
Living with children or teenager (0=no, 1=yes)	1.08 (0.84 to 1.39)	1.64 (1.26 to 2.13)	1.12 (0.86 to 1.47)	1.31 (0.98 to 1.74)	2.24 (1.66 to 3.02)
Industry of profession					
Others	1.00	1.00	1.00	1.00	1.00
Building industry	0.79 (0.55 to 1.13)	1.12 (0.81 to 1.70)	1.33 (0.91 to 1.95)	1.31 (0.87 to 1.99)	0.99 (0.64 to 1.53)
Manufacturing industry	0.82 (0.62 to 1.08)	0.86 (0.64 to 1.14)	0.87 (0.65 to 1.16)	1.01 (0.74 to 1.38)	0.91 (0.66 to 1.25)
Area of current residence in Fukushima prefecture					
Mountainous area	1.00	1.00	1.00	1.00	1.00
Other prefectures	0.70 (0.33 to 1.48)	0.36 (0.12 to 1.10)	1.56 (0.61 to 3.96)	1.91 (0.52 to 7.00)	1.25 (0.32 to 4.96)
Central area	1.68 (1.16 to 2.44)	2.01 (1.31 to 3.11)	2.97 (1.78 to 4.95)	7.38 (3.38 to 16.12)	4.80 (2.38 to 9.67)
Coastal area without the evacuation zone	1.78 (1.13 to 2.81)	2.79 (1.69 to 4.62)	6.74 (3.81 to 11.91)	13.89 (6.10 to 31.63)	6.95 (3.27 to 14.75)
Evacuated or not					
Did not evacuate	1.00	1.00	1.00	1.00	1.00
Government-ordered	1.71 (0.42 to 6.91)	1.20 (0.34 to 4.24)	1.07 (0.30 to 3.74)	3.26 (0.87 to 12.31)	1.39 (0.37 to 5.18)
Voluntary	0.71 (0.14 to 3.70)	0.31 (0.04 to 2.75)	1.41 (0.27 to 7.39)	0.31 (0.03 to 2.72)	2.76 (0.52 to 14.56)

DISCUSSION

The present study suggested that residents within 80 km from FDNPP, female gender, older age and living with children or teenagers were important determinants of some preventive behaviours against radiation among general workers in Fukushima after the nuclear disasters. This is the first study to report a prevalence of certain types of preventive behaviours displayed against radiation and to assess the factors that became associated with these behaviours among regular workers following the nuclear disasters.

Although there have been studies performed on the different types of preventive behaviours following a natural disaster,¹⁰ there have never been any studies that research the types of preventive behaviours following a nuclear accident. Our research studies the preventive actions taken against radiation by workers who participated in the FOHPC's seminars in Fukushima 3–5 months following the nuclear incidents. Our research is therefore significant as it clarifies which types of factors are associated with preventive behaviours in a short time span following a nuclear accident. Our results suggested that those who had related characteristics to display some preventive behaviours, such as female subjects and residents near the nuclear power plants, might be more sensitive for radiation protection than those who did not have them. Therefore, our results provide information that may help with the targeting of health information in the future.

The area in which the subject resided was associated with all of the top five responses in the list of preventive behaviours. Through this, it is evident that the closer people live to the FDNPP, the more likely they are to display preventive behaviours against radiation. The evacuation areas near the FDNPP were divided into three areas by the Japanese government:^{11 12} evacuation zone within a 20 km radius of the FDNPP, evacuation-prepared areas within a 20–30 km radius and deliberate evacuation areas outside of the 20 km radius where residents could potentially accumulate over 20 mSv of annual radiation. The government's separating and designating areas in radial distances like this may have created a relationship between radial distance from the

FDNPP and the preventive behaviours of its residents. This observation explains why residents living in coastal areas that are closer to the FDNPP were more likely to display preventive behaviours against radiation than others. Furthermore, the spread of radioactive materials was not determined by radial distance from the FDNPP, but by wind directions on the day of the nuclear accidents. Due to this, some areas in Fukushima resulted in having higher levels of radiation than others. For this reason, it was observed that people with tendencies to display preventive behaviours against radiation were those living close to the FDNPP such as residents from coastal areas and those from a wider range, including those from the central area, 40–80 km away from the FDNPP.

Furthermore, whether the worker was of female gender or not also had a positive association with each of the five most commonly displayed preventive behaviours. According to previous findings from the report titled 'Suicide Ideation after the 1999 Earthquake in Marmara, Turkey', the thought of suicide following an earthquake was 0.71 (95% CI: 0.60 to 0.85) times lower with female than with male subjects.¹³ Studies also reported that following the Hanshin-Awaji Earthquake in 1995, traumatic reactions among female undergraduate students decreased after 3 months, while feelings of survival guilt did not.¹⁴ Therefore, these reports suggested that female subjects were psychologically stronger than male subjects following large-scaled earthquakes. However, our study reports for the first time that female subjects are more likely to display preventive behaviours against radiation following a nuclear accident triggered by large-scaled earthquakes. This result likely was due to with factors that are less to do with the psychological toughness of female subjects, and more to do with other factors such as social responsibility and sensitivity. Then, our results indicated that gender was an independent factor to act on preventive behaviours independent of having children or not. Our results suggested the information to female subjects about radiation was given with greater care than that to male subjects.

Meanwhile, workers living with children or teenagers were associated with preventive actions such as washing hands and gargling, and refraining from going outside. A possible explanation for this association is adults living with children are acting the same way as they are instructing the children to act in order to minimise the amount of radiation the children are being exposed to. According to Fujiwara and coworkers, generally speaking, children have higher sensitivity to radiation and the related diseases than adults.¹⁵ Studies of the atomic bomb survivors in Hiroshima found that in cases of cancer and leukaemia, the age at the time of radiation exposure had effects on both early risks and temporal risks of radiation related conditions.¹⁵ The younger the age when exposed to radiation, the higher were the early risks while the larger the drops were in later temporal risks. For these reasons, adults living together with children are displaying adequate preventive behaviour by washing hands, gargling and refraining from going outside, as these behaviours indicate a desire by adults to reduce the chances of inner and outer radiation exposure by the children.

Finally, increases in age categories showed significances with behaviours such as keeping track of radiation levels using sources such as newspapers, and washing hands and gargling. It is possible that workers belonging to the older age groups were more likely to belong to senior positions at their workplace and were therefore expected to keep track of environmental radiation in order to supervise their coworkers' working conditions. The same reason may have also played a factor in why basic sanitary actions such as washing hands and gargling were more common with those belonging to older age groups. It is possible that workers belonging to senior positions need to act as role models in their workplaces, and actively practice sanitary actions like these in order to persuade other workers to follow, and therefore reduce overall radiation exposure.

There are some limitations in the present study. First, our study uses a cross-sectional design, which does not prove a causal relation. Second, these results include a selection bias and an eventual bias due to targeting only participants of a radiation seminar. These must be taken into consideration when interpreting our results. Finally, the results may show overestimations of preventive behaviours among participants, as the participants include regular workers and industrial health nurses and health supervisors who have relatively higher levels of knowledge with regard to radiation safety. To confirm this, more data will be needed.

CONCLUSIONS

In conclusion, we clarified that among general workers in Fukushima, those living within approximately 80 km of the nuclear power plants, female workers, those belonging to older age categories, and those living with children or teenagers were positively associated with preventive behaviours against radiation. The results of this study are significant, as they provide an

objective view on how general workers reacted on an individual basis against radiation following the nuclear disasters in Fukushima. Our results provide information that may help with the targeting of health information in the future.

Acknowledgements We are grateful to Mr Masamichi Kondo for the collection of the data, Ms Junko Ogata for the assembling, inputting and managing of the data, and to Mr William DY McMichael for the English editing of the manuscript.

Contributors HK initiated the study, designed the protocol, analysed data, wrote the paper and is the guarantor for the study. TH helped design the protocol, review the literature and analyse data. KK collected data and reviewed the literature.

Competing interests None.

Ethics approval Ethics approval was provided by Fukushima Occupational Health Promotion Center.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement Dr Kanda had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

REFERENCES

1. **The Chief Cabinet Secretary.** *Declaration of a Nuclear Emergency Situation*. 2011. http://kantei.go.jp/jp/tyoukanpress/201103/11_p3.html (In Japanese).
2. **Nuclear and Industrial Safety Agency, Japan Nuclear Energy Safety Organization.** *The 2011 off the Pacific Coast of Tohoku Pacific Earthquake and the Seismic Damage to the NPPs*. 2011. http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
3. **Wakeford R.** And now, Fukushima. *J Radiol Prot* 2011;**31**:167–76.
4. **Normile D.** Japan disaster: citizens find radiation far from Fukushima. *Science* 2011;**332**:1368.
5. **Nuclear and Industrial Safety Agency.** *Responding to a Nuclear Emergency*. 2011. <http://www.nisa.meti.go.jp/english/files/en20110316-1.pdf>
6. **The Fukushima Prefectural Government.** *Radiation Q&A*. 2011. http://www.cms.pref.fukushima.jp/pcc_portal/PortalServlet?DISPLAY_ID=DIRECT&NEXT_DISPLAY_ID=U000004&CONTENTS_ID=23741 (In Japanese).
7. **The Fukushima Prefectural Government.** *Evacuees from Fukushima Prefecture to other Prefectures*. 2011. <http://www.pref.fukushima.jp/j/kengaihinanuchiwake0822.pdf> (In Japanese).
8. **Ministry of Internal Affairs and Communications.** *Report on Internal Migration in Japan after the Great East Japan Earthquake*. 2011. <http://www.stat.go.jp/info/shinsai/pdf/youyaku8.pdf> (In Japanese).
9. **The Statistics Bureau of the Fukushima Prefectural Government.** *Monthly Report on Wage, Work Time and Employment in Fukushima Prefecture*. 2011. <http://www.pref.fukushima.jp/toukei/data/01/maikin/maikin23/mk2305.pdf> (In Japanese).
10. **Adini B, Cohen R, Bar-Dayyan Y.** Risk and protective factors that impact survival in emergencies—the time has come for an upgrade in preventive emergency population behavior. *Prehosp Disaster Med* 2008;**23**:507–9.
11. **The Prime Minister.** *Message from the Prime Minister. Speeches and Statements by Prime Minister*. 2011. <http://kantei.go.jp/saigai/pdf/201104220944siji.pdf> (In Japanese).
12. **Ministry of Economy, Trade and Industry.** *Restricted Area, Deliberate Evacuation Area, Evacuation-Prepared Area in case of Emergency and Regions including Specific Spots Recommended for Evacuation*. 2011. http://www.meti.go.jp/english/earthquake/nuclear/roadmap/pdf/evacuation_map_a.pdf
13. **Vehid HE, Alyanak B, Eksi A.** Suicide ideation after the 1999 earthquake in Marmara, Turkey. *Tohoku J Exp Med* 2006;**208**:19–24.
14. **Hyodo K, Morino R.** A study of mental and physical reactions after the Hanshin-Awaji Earthquake: mental and physical conditions of female undergraduate students immediately after, 2 months after, and 9 months after the earthquake. *Shinrigaku Kenkyu* 1999;**70**:104–11 (In Japanese).
15. **Fujiwara S, Yamada M, Kodama K.** Affect to radiation exposure for children. *Shounika* 2000;**41**:2033–9 (In Japanese).



Preventive behaviours against radiation and related factors among general workers after Fukushima's nuclear disasters

Hideyuki Kanda, Takehito Hayakawa and Kikuo Koyama

Emerg Med J published online May 16, 2012
doi: 10.1136/emmermed-2011-201000

Updated information and services can be found at:
<http://emj.bmj.com/content/early/2012/05/15/emmermed-2011-201000.full.html>

These include:

- | | |
|-------------------------------|---|
| References | This article cites 6 articles, 1 of which can be accessed free at:
http://emj.bmj.com/content/early/2012/05/15/emmermed-2011-201000.full.html#ref-list-1 |
| P<P | Published online May 16, 2012 in advance of the print journal. |
| Email alerting service | Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article. |
-

Notes

Advance online articles have been peer reviewed, accepted for publication, edited and typeset, but have not yet appeared in the paper journal. Advance online articles are citable and establish publication priority; they are indexed by PubMed from initial publication. Citations to Advance online articles must include the digital object identifier (DOIs) and date of initial publication.

To request permissions go to:
<http://group.bmj.com/group/rights-licensing/permissions>

To order reprints go to:
<http://journals.bmj.com/cgi/reprintform>

To subscribe to BMJ go to:
<http://group.bmj.com/subscribe/>