

# The Fukushima nuclear accident temporarily increased patients reluctance for nuclear medicine investigations

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## Abstract

Only mentioning the word "nuclear" already creates anxiety and distress. We attempted to assess the impact of the media hype about the Fukushima event on patients admitted in nuclear medicine units to undergo diagnostic investigations. The number of patients denying scintigraphic studies over half a year after the Fukushima accident was compared with the same period of the 2 previous years 2009 and 2010. Data were separately analyzed into thyroid vs. other organ scintigraphies. Physicians' referrals to nuclear medicine showed no decline. Patients undergoing various organ scintigraphies asked questions related to the accident but only few of them denied the investigation. Questioning and denial for nuclear medicine tests were more frequent in females as compared to males and especially in child-bearing females. Among patients referred in the initial post-event phase for thyroid function tests, more than 10% denied thyroid scintigraphy and 2.75% questioned this test. Again, questioning and denial was higher with females, especially in child-bearing age. In conclusion, this study showed that nuclear accidents and perhaps irresponsible media reports may affect behaviour of patients referred for nuclear medicine studies and in particular for thyroid scintigraphy even if these accidents had no radioactive effect to them.

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## Introduction

The history of nuclear technology is also a history of accidents in a wide range of severity associated with release of radioactivity in the environment [1] by spreading speculations and non verified statements. The behaviour of authorities involved, experts and news media may generate hype, hysteria and panic. In our days any information related to the term "nuclear", should be consciously presented because it may cause anxiety and distress [2, 3].

Already after the Chernobyl accident being much closer and more relevant for Europe, that the Fukushima accident, patients did ask and are still asking whether their thyroid problems might eventually have derived from that accident, particularly in Austria; a country with a high critical awareness for nuclear energy.

We aimed to assess the number of patients questioning or denying a scintigraphic investigation in Austria on the background of the recent Fukushima accident as compared to the previous years.

## Subjects and methods

The number of adult persons who denied and questioned thyroid and other organ scintigraphies after Fukushima accident on March 11<sup>th</sup>, 2011 and during the subsequent half-year (April to September) was assessed and compared to the data of the same period of 2 previous years (2009, 2010) in the Institute of Nuclear Medicine Unit in Vienna (Tables 1a, b, c and 2), children were excluded. Data are given as number and percentage of the total number of the respective investigations performed at the same periods of time. We performed more than 4200 thyroid scintigraphies every year from the mid of March to the end of September and also analysed organ scintigraphy in more than 2100 subjects at the same time. In thyroid patients about two thirds were females, with organ scintigraphies gender distribution in total being about equal. Furthermore, age distribution over the 3 years of study was about equal. Details on the total number of patients, gender and the ones questioning or denying the diagnostic test are given in Tables 1a, b, c, and 2. All persons studied gave their written informed consent for this study.

**Table 1a. Thyroid scintigraphies in 2009**

	Total	Scintigraphy		Denied		Questioned	
	n m/f	n m/f	% m/f	n m/f	% m/f	n m/f	% m/f
March	567	228	40.21	0	0.00	2	0.88
12-31	226/341	79/149	34.96/43.69	0/0	0.00/0.00	0/2	0.00/1.34
April	718	295	41.09	2	1.35	4	0.68
	216/502	87/208	40.28/41.43	1/1	1.14/0.48	1/3	1.15/1.44
May	529	228	43.19	1	1.35	3	0.44
	156/373	81/147	51.92/39.41	0/1	0.00/0.68	1/2	1.23/1.36
June	758	327	43.14	3	1.22	4	0.92
	224/534	102/225	45.54/42.13	1/2	0.98/0.89	2/2	1.96/0.89
July	663	297	44.79	2	1.68	5	0.67
	199/464	68/229	34.17/49.35	0/2	0.00/0.87	1/4	1.47/1.75
August	530	209	39.43	0	0.00	2	0.96
	157/373	73/136	46.49/36.46	0/0	0.00/0.00	0/2	0.00/1.47
September	677	283	41.80	1	1.06	3	0.35
	202/475	79/204	39.11/42.95	0/1	0.00/0.49	1/2	1.27/0.98
Total	4442	1867	42.03	9	1.23	23	0.48
	1380/3062	569/1298	41.23/42.39	2/7	0.35/0.54	6/17	1.05/1.31

m: males; f: females

## Results

Despite the usual fluctuations in number and distribution of organ scintigraphies in our nuclear medicine units in both countries, no significant change in referral of patients for nuclear medicine studies by physicians of various disciplines, (data not shown) after Fukushima accident was noted. In Vienna, interestingly, only 6 (out of 2015; 0.29%) organ scintigraphies have been denied in the 6 ½ months follow-up

period after Fukushima accident, while 79 patients (4.27% - Table 1c) refused to undergo thyroid scintigraphy in the same period and most of them during the first 2 weeks (n=22; 1.2%). Most of these patients were females (n=20). In Vienna, denials and questioning about the tests of females in child-bearing age (18-48 years) was about double as high as in older women (44-82 years) and even higher in those having children (data not shown). Interestingly, at the same time none of the thyroid patients at Perugia University Nu-

**Table 1b. Thyroid scintigraphies in 2010**

	Total	Scintigraphy		Denied		Questioned	
	n m/f	n m/f	% m/f	n m/f	% m/f	n m/f	% m/f
March	403	172	42.68	1	0.58	1	0.58
12-31	124/279	63/109	50.81/39.07	0/1	0.00/0.92	0/1	0.00/0.92
April	697	286	41.03	1	0.35	0	0.00
	208/489	84/202	40.38/41.31	0/1	0.00/0.49	0/0	0.00/0.00
May	675	308	45.63	2	0.65	2	0.65
	186/489	99/209	53.23/42.74	0/2	0.00/0.96	1/1	1.01/0.48
June	774	309	39.92	1	0.32	0	0.00
	241/533	104/205	43.15/38.46	0/1	0.00/0.49	0/0	0.00/0.00
July	605	267	44.13	2	0.75	4	1.50
	193/412	91/176	47.15/42.72	0/2	0.00/1.14	1/3	1.09/1.70
August	500	205	41.00	1	0.49	3	1.46
	161/339	62/143	38.51/42.18	1/0	1.61/0.00	0/3	0.00/2.09
September	601	232	38.60	0	0.00	2	0.86
	194/407	69/163	35.57/40.05	0/0	0.00/0.00	1/1	1.45/0.61
Total	4255	1779	41.08	8	0.45	12	0.67
	1307/2948	572/1207	43.76/40.94	1/7	0.17/0.58	3/9	0.52/0.75

m: males, f: females

**Table 1c.** Thyroid scintigraphies in 2011

	Total	Scintigraphy		Denied		Questioned	
	n m/f	n m/f	% m/f	n m/f	% m/f	n m/f	% m/f
March	533	218	40.90	22	10.09	6	2.75
12-31	149/384	68/150	45.64/39.06	2/20	2.94/13.33	1/5	1.47/3.33
April	660	295	44.69	19	6.44	4	1.36
	259/401	91/204	35.14/50.87	3/16	3.29/7.84	1/3	1.09/1.47
May	757	321	42.40	14	4.36	6	1.87
	257/500	112/209	43.58/41.80	3/11	2.68/5.26	1/5	0.89/2.39
June	595	259	43.53	11	4.25	4	1.54
	177/418	90/169	50.84/40.43	2/9	2.22/5.33	1/3	1.11/1.78
July	600	264	44.00	6	2.27	8	3.03
	179/421	89/175	49.72/41.57	2/4	2.25/2.29	3/5	3.37/2.86
August	631	264	41.84	3	1.14	5	1.89
	208/423	84/180	40.38/42.55	1/2	1.19/1.11	1/4	1.19/2.22
September	573	228	39.79	4	1.75	4	1.75
	169/404	79/149	46.75/36.88	1/3	1.27/2.01	2/2	2.53/1.34
Total	4349	1849	42.52	79	4.27	37	2.00
	1398/2951	613/1236	43.85/41.88	14/65	2.28/5.26	10/27	1.63/2.18

m: males, f: females

clear Medicine Unit (SC Medicina Nucleare 2, Az. Ospedaliera di Perugia) refused thyroid scintigraphy.

Denied thyroid scintigraphies reached 10% in the initial 2 weeks and there was a continuous decline thereafter. After half a year the absolute level was still about 4-fold (Table 1c) as compared to the 2 previous years (Tables 1a, 1b). Anxiously questioning, in relation to the nuclear accident was also several-fold increased over half a year ranging around 2%, as compared to about a quarter of this number during the same period of 2009 and 2010. The gender difference for anxiously questioning was less pronounced as compared to denials.

## Discussion

The Fukushima accident not only had a severe social impact in Japan and in neighbouring countries, but also severely influenced social behaviour of citizens from other countries not contaminated by radioactive fall out from this accident [4, 5]. Although Europe is far away and there was never any health risk for its population [6], this accident had been misused by many so-called experts from various disciplines for statements, sometimes being far from reality, driving people in a status of anxiety and eventually inducing the "anchoring effect" [7]. As an example, shortly after the Fukushima accident a journalist phoned one of us (HS) asking about the radiation dose in the Fukushima area and how many people will soon die after the accident. Refusing to give a comment because no related data were available by that time and saying to the reporter that such a comment would make no sense for our country, he answered that this might be true but his editor-in-chief asks for and insists on these answers. Certainly enough, many comments having been delivered after Fukushima accident were eventually for the benefit of the presenter but not for that of the public.

Especially, any comment on the liberation of radioiodine after nuclear accident, apparently affects population emotionally and relate this radionuclide with thyroid disease and thyroid scintigraphy. This may explain why during our study questioning and refusal of thyroid scintigraphies was the predominant problem as compared to other organ scintigraphies in the respective period of time. During the first two weeks after the accident questioning concerning thyroid scintigraphy was mainly by mothers, asking whether they could stay after scintigraphy, close to their children or to other family members. Frequently asked questions were: Is that the same radioisotope liberated in Fukushima? Is the dose I get comparable to the one people received around the reactor? or: After I get the radioactive material am I to become a small Fukushima? Decision making of these women is influenced by the "anchoring effect", a focalism which occurs as a cognitive bias when the first information learned on a certain subject influences later information analysis and decision making [7].

The International Atomic Energy Agency (IAEA) even weeks after the Fukushima accident was not providing any information even to insiders. In Italy, the Ministry of Health in collaboration with the Regional Governments of Italy organized a number of Reference Centers able to control and take care of subjects who returned to Italy after staying near Fukushima at the time of the accident and also the Ministry issued an official document on March 25<sup>th</sup>, 2011 to define the related official protection procedures ([http://www.nor-mativasanitaria.it/normsan-pdf/0000/37625\\_1.pdf](http://www.nor-mativasanitaria.it/normsan-pdf/0000/37625_1.pdf)). More information was available on the website ([www.salute.gov.it](http://www.salute.gov.it)). Institutes of nuclear medicine and medical physics in Austria and Italy offered to test urinary radioactivity in subjects returning from places near Fukushima (for example flight personnel). In Umbria, Italy, 4 nuclear medicine units (2 in Perugia, 1 in Terni and 1 in Foligno) were appointed by the Ministry of Health as Reference Centers. In Austria, neither

**Table 2a. Organ scintigraphies**

	2009					2010	
	Total	Denied		Questioned		Total	Denied
	n m/f	n m/f	% m/f	n m/f	% m/f	n m/f	n m/f
March	204	0	0.00	0	0.00	232	0
12-31	114/90	0/0	0.0/0.0	0/0	0.00/0.00	174/58	0/0
April	346	0	0.00	2	0.58	378	1
	171/175	0/0	0.0/0.0	0/2	0.00/1.14	206/172	0/1
May	316	0	0.00	3	0.95	336	1
	149/167	0/0	0.0/0.0	1/2	0.67/1.19	169/167	0/1
June	351	0	0.00	1	0.28	370	0
	156/195	0/0	0.0/0.0	0/1	0.00/0.51	188/182	0/0
July	351	0	0.00	2	0.57	363	0
	164/187	0/0	0.0/0.0	1/1	0.61/0.53	191/172	0/0
Aug.	251	0	0.00	2	0.79	329	1
	129/122	0/0	0.0/0.0	0/2	0.00/1.64	171/158	0/1
Sept.	353	1	0.28	4	1.13	368	0
	192/161	0/1	0.00/0.62	1/3	0.52/1.86	194/174	0/0
Total	2172	1	0.005	14	0.64	2376	3
	1075/1097	0/1	0.00/0.009	3/11	0.027/0.10	1293/1083	0/3

Aug.: August, Sept.: September, m: males, f: females

**Table 2b. Organ scintigraphies**

	2011						
	Questioned		Total	Denied		Questioned	
	% m/f	n m/f	n m/f	n m/f	% m/f	n m/f	% m/f
0.00	2	0.86	251	2	0.79	12	4.78
0.00/0.00	1/1	0.87/1.72	147/104	1/1	0.57/0.96	2/10	1.36/9.62
0.26	3	0.79	316	2	0.63	13	4.11
0.00/0.58	1/2	0.49/1.16	186/130	0/2	0.00/1.54	3/10	1.61/7.69
0.29	1	0.29	354	0	0.00	8	2.26
0.00/0.59	0/1	0.00/6.59	192/162	0/0	0.00/0.00	2/6	1.04/3.70
0.00	2	0.54	294	1	0.34	7	2.38
0.00/0.00	1/1	0.58/0.55	169/125	0/1	0.00/0.80	2/5	1.18/4.00
0.00	2	0.55	306	0	0.00	4	1.31
0.00/0.00	0/2	0.00/1.16	167/139	0/0	0.00/0.00	1/3	0.59/2.16
0.30	1	0.30	220	1	0.45	3	1.36
0.00/0.63	0/1	0.00/0.63	135/85	0/1	0.00/1.18	1/2	0.74/1.18
0.00	2	0.54	274	0	0.00	4	1.46
0.00/0.00	0/2	0.00/1.15	149/125	0/0	0.00/0.00	2/2	1.34/1.60
0.001	12	0.51	215	6	0.29	51	2.53
0.00/0.027	3/10	0.023/0.092	1145/870	1/5	0.006/0.057	13/38	0.89/4.37

the respective societies like nuclear medicine, radiation protection and physicists' Societies nor the government provided an official expert statement. Only personal comments by various specialists were delivered. Apparently, a big differ-

ence between Austria and Italy in perception and reaction of people and patients towards Fukushima accident existed. Although the majority of patients understood the difference between undergoing a necessary examination with a radio-

active compound of low activity, and being submitted to irradiation from in Fukushima accident, they still felt a temporary uncertainty.

Appropriate information is necessary for all professional staff. Intentional over- and/or underestimation of the stimulation for obvious reasons is harming people, in particular those being scheduled to undergo radioisotopic examinations. Finally, these statements are an additional threat to the discipline of nuclear medicine in our days, when problems of availability of technetium-99m and of relations with the discipline of radiology exist.

An ever rising percentage of about 15% of the total population exposure to ionizing radiation is due to medical procedures, nuclear medicine contributing only to about 1% of the total and 7% of all medical procedures [8]. This figure varies considerably in different countries but per capita has increased over the last decade by 2.3 for CT, by 1.8 for conventional radiography and by 1.5 for nuclear medicine [9].

*In conclusion*, the Fukushima accident had a rather significant impact on subjects tested by nuclear medicine procedures, mainly due to the behaviour of some experts and some reporters and the fact that public and private authorities did not properly inform the public.

*The authors declare that they have no conflicts of interest.*

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