The novel terminology ‘discernible’ undiscerned Conclusions: A Critical Review of UNSCEAR 2020/21 Fukushima Report

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Abstract- On March 2022, the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) released the updated Fukushima Report 2020/21. Through this critical review, I identified serious problems. (1) The Report introduced the novel terminology ‘discernible’ that is equivalent to statistically enough power to detect increases in cancer. The Report explains that ‘“no discernible increase” did not equate to an absence of risk (Para. 213)’. In fact, for ‘females of ages in utero to five years at initial exposure, about 16 to 50 cases of thyroid cancer attributable to radiation could be inferred (snip) A statistical power analysis showed that an excess of 50 cases or less would be undetectable (Para. 222)’. However, UNSCEAR’s news releases and briefings do not explain the meaning of ‘discernible’, leading reporters and the general public to misinterpret ‘no discernible’ is ‘no risk’. That is a fatal failure in risk communication. (2) For thyroid cancers identified in Fukushima Ultrasound Examination (TUE), the Report concludes ‘the excess does not appear to be associated with radiation exposure, but rather a result of the application of highly sensitive ultrasound screening procedures (Para. 246)’. Because compared to Chernobyl, where a significant increase was observed among children under five years after four years of the accident, in Fukushima, a large part of thyroid cancer was detected in adolescents within three years. The report missed the context of TUEs in Chornobyl and Fukushima: TUE in Chernobyl started in the 1990s or after 4–5 years of the accident; in Fukushima, TUE started after a half year. Moreover, the literature review in the Report does not understand the limitations of the studies that reported insignificant relationships between radiation and thyroid cancer, suffered a lack of statistical power, and/or improper analysis. (3) For solid cancer (excluding melanoma and thyroid cancer), UNSCEAR’s statistical power analysis in Attachment A-23 indicated a lifetime increase likely to be detectable (LFR is 1.2% for 10-year-old girls subpopulation with a statistical power of 0.80). On the contrary, the report describes, ‘the levels of exposure of members of the public have been too low for the Committee to expect distinctive increases in the incidence of breast cancer or other solid cancers (Para. 247)’. A Critical review revealed severe problems in the UNSCEAR2020/21 Fukushima Report; thus the Report must be corrected or updated accordingly.

Keywords: Fukushima nuclear disaster; UNSCEAR; Thyroid cancer; Statistical power analysis

1. INTRODUCTION

UNSCEAR published its 2013 Report on the Fukushima nuclear disaster in 2014 (UNSCEAR, 2014) and has since periodically released white papers that review the published Fukushima-related papers. The UNSCEAR 2020/21 report (UNSCEAR, 2022b) is a revised version that reflects findings since the 2013 report. Due to space limitations, this study critically examines ‘Health implications for the public’ of the Report in terms of risk communication, thyroid ultrasound examination, and power analysis.

2. RESULTS

2.1. Serious failure of risk communication: Misinterpretation caused by failure to explain the meaning of the ambiguous word 'discernible'

UNSCEAR released a draft version of the updated Fukushima report (UNSCEAR, 2021b) in March 2021. The press release at the time was titled 'Radiation-linked increases in cancer rates not expected to be seen' (UNSCEAR, 2021a). It reads as if the report denies the future occurrence of cancer. Moreover, the press release describes that 'UNSCEAR said that future health effects, e.g., cancer directly related to radiation exposure are unlikely to be discernible' without estimation method. Here, the unfamiliar word 'discernible' is utilized, that was introduced in the 2013 Report, describing it as (UNSCEAR, 2022b):

213. The Committee explained that, in estimating values of the risk of stochastic effects due to exposure for members of various exposed groups, it has used the term "discernible" for cases where the estimated risk of the disease was sufficiently large in a large enough population to be detectable, compared to the normal statistical variability in the baseline incidence of the disease in that population. Conversely, when risks may be inferred from existing knowledge (i.e., using models), but the level of the inferred risk is low and/or the number of people exposed is small, the Committee has used the phrase "no discernible increase" to express the idea that currently available methods would most likely not be able to demonstrate an increased incidence in the future disease statistics due to irradiation (that is, the attributable risk is too small compared to the baseline levels of risk to be detected). The Committee emphasized that its use of the term "no discernible increase" did not equate to an absence of risk or rule out the possibility of excess cases of disease due to irradiation, nor the possibility of detection of a biomarker for certain types of cancer in certain subgroups being identified in the future that could be associated with radiation exposure. Nor was it intended to disregard the suffering associated with any such cases should they occur.

According to this explanation, 'discernible' seems to have a meaning similar to that of 'statistical significance'. Just as an 'insignificant relationship between radiation dose and incidents of cancer' does not necessarily mean 'no risk', not discernible doesn't mean 'no risk'. In fact, the report explains the possible risk of developing thyroid cancer as follows (UNSCEAR, 2022b, Para. 222):

females of ages in utero to five years at initial exposure comprise the most susceptible subgroup. For this subgroup, about 16 to 50 cases of thyroid cancer attributable to radiation could be inferred from the estimated exposure, depending on the risk model assumed. (snip) A statistical power analysis showed that an excess of 50 cases or less would be undetectable.

As explained, the risk of developing thyroid cancer is predicted but can not be detected because of noise. The meaning of 'discernible' is explained in the report but not in the press release, which caused misunderstanding of 'no risk' of radiation.

In March 2022, UNSCEAR released the finalised Fukushima report 2020/21 (UNSCEAR, 2022b) and conducted an outreach in Japan in July 2022. The presrelease of outreach also

failed to explain the meaning of 'discernible'[1]. The meaning of 'discernible'[2] was not explained during UNSCEAR outreach. This led to news reports misinterpreting 'undiscernible' as 'no risk'. For example, one newspaper reported that 'it is unlikely that there will be an increase in cancer and other health effects from exposure'[3]. Another TV station reported that 'On July 20, the former chairman of the United Nations Scientific Committee visited Governor Uchibori of Fukushima Prefecture and reported the results of the report that there were no health effects from radiation exposure'[4]. In both cases, 'discernible' was omitted, leading to the misunderstanding that UNSCEAR concluded 'unconditionally' that there were or will be no adverse health effects from radiation exposure.

'No risk' and 'risk is possible but not detectable' are completely different situations. In the latter case, health examination should be enhanced to detect health risk, and medical responses should be prepared when it becomes apparent. If a 'risk is possible but not detectable' situation was misinterpreted as 'no risk', the harm could not be detected, and the damage could be magnified.

According to WHO, 'The purpose of risk communication is to enable people at risk to make informed decisions to mitigate the effects of a threat (hazard) – such as a disease outbreak – and take protective and preventive measures.' (WHO, 2022). The use of the novel word 'discernible' and the failure to fully explain its meaning, causing misunderstanding, is a fatal failure of UNSCEAR's risk communication. UNSCEAR should explain the meaning of 'discernible' and strengthen testing and medical response.

2.2. Concluding on thyroid cancer without understanding the examination protocol

In Fukushima Prefecture, about 300,000 children and young adults under the age of 18 at the time of the Fukushima nuclear disaster were screened for thyroid cancer by ultrasound, and about 300 cases of thyroid cancer, including suspicious, have been detected so far. For thyroid cancer detected through thyroid ultrasound examination, the report concludes (UNSCEAR, 2022b):

the excess does not appear to be associated with radiation exposure, but rather a result of the application of highly sensitive ultrasound screening procedures. (snip) (Because) (a) no excess of thyroid cancer has been observed in those exposed before age 5, in contrast to the large excess observed in the same age group exposed as a result of the Chernobyl accident; and (b) thyroid cancers were observed within 1 to 3 years after exposure following the

[1] no adverse health effects due to radiation exposure have been documented in the residents of Fukushima that could be directly attributed to radiation exposure from the accident, and it is unlikely that any such effects will be observed in the future.

[2] During outreach in Japan, the UNSCEAR team held briefing at the Japan Press Club, Tokyo Institute of Technology (TIT), Fukushima Medical University, and Iwaki City. The present author posted the following question and comment at the Tokyo Institute of Technology Scientific meeting held on 7/19/2022.

Could you elaborate meaning of 'discernible'? According to my understanding of the description in paragraph 222, you expect 16 to 50 excess thyroid cancer for under 5 years old girls. But you estimated you can not identify them because of noise and small sample size. Is it right? If it was right, it is completely different from 'no risk of cancer'. You should explain, 'there is a certain risk of cancer, but we expect we can not detect them'.

Dr. Balonov replied that 'It is difficult to determine significance level.' that was not replyto my question and comment.

[3] Yomiuri Shinbun 2022/7/19 "UNSCEAR says no health damage caused by radiation exposure is not recognized after Fukushima nuclear" disaster. Available at https://www.yomiuri.co.jp/science/20220719-OYT1T50202/ (in Japanese) (last accessed 31 December 2022)

[4] TV You Fukushima "The United Nations Scientific Committee visits Fukushima." https://web.archive.org/web/20220720133407/ and https://newsdig.tbs.co.jp/articles/-/100709?display=1 (last accessed 31 December 2022) (in Japanese).

FDNPS accident rather than beginning 4 to 5 years after exposure as in Chernobyl and other radiation studies.

UNSCEAR missed the results and the protocol of TUE in Fukushima. Although in the first round of TUE, no cancer was detected among children exposed before age 5, from the second to the fifth rounds of TUE in Fukushima, 16 thyroid cancers were detected in the group (POC for FHMS, 2022). Moreover, as UNSCEAR 2008 Chernobyl Report recognises, 'the number of ultrasound examinations increased dramatically in all oblasts between 1990 and 2002, over 20-fold in Chernihiv and Zhytomyr Oblasts' (Likhtarov et al., 2006). Thus, part of the increase in the observed thyroid cancer incidence may be attributable to the improved detection of cancers because of the greater use of ultrasonography (UNSCEAR, 2008), Para. D82.). The increase after four years of the Chernobyl accident is attributable to an increase in screening rather than latency.

Furthermore, although the target of screening in Belarus by Sasakawa Zaidan were 0–9 years old at the time of the accident (Yamashita and Shibata, 1997), the participants were concentrated 0–5 years old (see Table 1). Thyroid cancer was found more frequently in children under the age of five at the accident, starting four years after the accident was attributed by biased TUE. In Fukushima, by contrast, 0–18 year-olds are examined six months after the accident. Although the participation rate is slightly lower among high school students aged 15 and older, the age distribution of participants is not as distorted as in Chernobyl. UNSCEAR failed to understand the differences in the examination context in Chernobyl and Fukushima.

2.3. Concluding on thyroid cancer without understanding the limitations in previous studies

In addition, although the UNSCEAR compiles a list of previous studies that analysed thyroid cancer in Fukushima (Table 16 in UNSCEAR, 2022b), they do not understand their limitations. For example, Suzuki et al. (2016) and Ohira et al. (2016), which reported no regional differences in cancer detection rates, lack the statistical power at a detection rate of 0.03% as criticised by the present author (Hamaoka, 2016, 2017). Ohira et al. (2020), that excluded children aged five years or younger at the time of the accident from their analysis and analysed the remaining samples separately for those aged 6–14 years and those aged 15 years or older, found *a negative and significant* relationship between the UNSCEAR estimated thyroid absorbed dose and the detection rate of thyroid cancer in the latter group. Their results contradicted common knowledge of radiation epidemiology that identified linear dose-response with positive slope (NCRP, 2018), and the validity of the analysis should be questioned. Unfortunately, UNSCEAR 2020/21 report missed these limitations.

Thus, the conclusions of the UNSCEAR report, which does not understand the context of TUE in Fukushima, and which does not thoroughly examine the previous studies on thyroid in Fukushima, are hardly plausible.

Table 1. Result of thyroid screening in Belarus by Sasakawa Project during 1991-1996*.

	Age at the accident	Participants			Thyroid Anomalies			Thyroid Cancer		
		Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
Number	0	1,383	1,391	2,774	73	86	159	0	5	5
	1	1,350	1,361	2,711	69	107	176	2	9	11
	2	1,284	1,300	2,584	64	102	166	2	2	4
	3	1,211	1,267	2,478	75	115	190	4	3	7
	4	1,115	1,257	2,372	87	146	233	2	1	3
	5	938	1,073	2,011	58	143	201	0	1	1
	6	719	817	1,536	64	116	180	1	2	3
	7	434	452	886	40	53	93	0	1	1
	8	257	300	557	14	36	50	0	0	0
	9	163	195	358	0	10	10	1	1	2
	Total	8,854	9,413	18,267	544	914	1,458	12	25	37
Cases per 100,000 participants	0				5,278.4	6,182.6	5,731.8	0.0	359.5	180.2
	1				5,111.1	7,861.9	6,492.1	148.1	661.3	405.8
	2				4,984.4	7,846.2	6,424.1	155.8	153.8	154.8
	3				6,193.2	9,076.6	7,667.5	330.3	236.8	282.5
	4				7,802.7	11,615.0	9,822.9	179.4	79.6	126.5
	5				6,183.4	13,327.1	9,995.0	0.0	93.2	49.7
	6				8,901.3	14,198.3	11,718.8	139.1	244.8	195.3
	7				9,216.6	11,725.7	10,496.6	0.0	221.2	112.9
	8				5,447.5	12,000.0	8,976.7	0.0	0.0	0.0
	9				0.0	5,128.2	2,793.3	613.5	512.8	558.7
	Total				6,144.1	9,710.0	7,981.6	135.5	265.6	202.6

*Source) Table A15-T01, Table A17-T01, and A19-T01 in Yamashita and Shibata (1997).

2.4. Descriptions that differ from the analysis results

The 2020/21 Report (Para. 247) summarises the results of health implications:

Likewise, the levels of exposure of members of the public have been too low for the Committee to expect distinctive increases in the incidence of breast cancer or other solid cancers.

This is against the result of Attachment-23 that conducted power analysis (UNSCEAR, 2022a), in which the lifetime risk of all solid cancer (excluding thyroid cancer and nonmelanoma skin cancer) for female 10 years old age subpopulation is estimated at 1.8% with a statistical power of 0.80 for a municipal average dose (Table A 23.9 in Attachment-23). The results are explained in the Attachment as follows (UNSCEAR, 2022a):

A potential exception to this occurred for females initially exposed at age 10, with a related value for both sexes: statistical power achieved the 80% criterion for the mean dose, indicating that one might potentially see a radiation-associated excess in this subpopulation (but see caveats in the next paragraph).

As mentioned within parentheses, four caveats are described in paragraph 46 of Attachment-23, which is not convincing. For example, for reason (a), even 'very small", possible risks must be avoided to protect the general public. Reason (b) missed Japanese cancer statistics experts say that the Japanese cancer registry is sufficiently accurate to detect the effect of radiation exposure-caused cancers[5]. For reason (c), if the uncertainty of the parameters were evaluated, much higher power would be obtained for the upper bound of the parameter. Furthermore, reason (d) ignores the fact that the statistical power exceeds 80% not only in the upper 95% dose but also in the average dose population.

The Report's conclusion (Para. 247) failed to understand that strong statistical power was obtained even with 'too low level of exposure'.

3. SUMMARY AND CONCLUSIONS

In this short paper, I reported the results of a critical review on Health Implications: General Public. A review revealed severe problems in the UNSCEAR 2020/21 Report. The descriptions in the report contradict the analysis results; the Report must be corrected or updated accordingly. As I pointed out, risk communication must also be improved, which caused a misunderstanding of the results of the Report.

Due to space limitations, in this short paper, three limitations are summarised. Other problems that include methods of statistical power analysis, estimation of thyroid absorbed dose, and others will be reported elsewhere.

4. ACKNOWLEDGEMENT

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