Correspondence

(The Editors do not hold themselves responsible for opinions expressed by correspondents)

Radiation increased the longevity of British radiologists

The Editor—Sir,
The 100-year study of British radiologists [1] is perhaps the most important article about the health effects of radiation on humans ever published. The continuity of follow-up in the study is the longest for any study of exposure to chronic radiation. The dose range over the 100-year study period, from 1897–1997, is very large, with exposures before 1920 estimated to be over 100 R year$^{-1}$ (1 Sv year$^{-1}$).

The authors appear not to have noticed the health benefits from radiation, especially in regard to significantly lower deaths from non-cancer even for the earliest radiologists. The very significant decrease in deaths from non-cancer and the lack of any significant increase in cancer deaths for radiologists after 1920 make it apparent that recommended dose limits for radiation workers are set too low for good health. The purpose of this letter is to call attention to the health benefits of a moderate radiation dose rate demonstrated in the data but not mentioned by the authors.

Table 2 of the article presents the standardized mortality ratio (SMR) for deaths from all causes, all cancers and all non-cancers for British radiologists compared with the SMR of three groups: (i) all men in England and Wales, (ii) all social class I males and (iii) all male medical practitioners. Radiologists were divided into four groups depending on when they joined one of the two British radiological societies: 1897–1920; 1921–1935; 1936–1954; and 1955–1979. The British X-ray Safety Committee, formed in 1920, played an important role in reducing occupational doses to radiologists in later decades.

Early British radiologists (1897–1920) had a SMR for cancer that was 75% higher than the SMR for cancer of all male physicians. The increased cancer mortality was clearly a result of their large radiation dose. However, even the heavily exposed pre-1921 radiologists had a SMR for non-cancer 14% lower ($p<0.05$) than the SMR for non-cancer of all male medical practitioners. Since 80% of the radiologists died from non-cancer causes, the decreased SMR for non-cancer completely cancelled their 75% excess cancer mortality. In other words, even the earliest radiologists did not suffer any decrease in longevity owing to their large exposures. The risk could be considered as zero.

Exposures of British radiologists were reduced starting in 1920 owing to the activities of the British X-ray Safety Committee. After 1920, radiologists’ overall health improved. Considered as a group, all radiologists registered after 1920 (1921–1979) showed no significant difference in cancer SMR compared with other physicians. However, these radiologists had a significantly lower cancer SMR than all men (SMR = 0.63; $p<0.001$) or their class I peers (SMR = 0.82; $p<0.01$). In addition, the post-1920 registrants had a lower SMR for deaths from all causes than other male physicians (SMR = 0.91; $p<0.01$), social class I males (SMR = 0.91; $p<0.01$) or all men (SMR = 0.72; $p<0.001$).

Cancer rates amongst radiologists dropped significantly below those for the general public starting in 1936 (SMR for 1936–1954 = 0.66; $p<0.001$). This was at a time when the only dose limit in effect was the “tolerance dose” of 0.2 R day$^{-1}$ (2 mSv day$^{-1}$).

The most dramatic health results are seen in radiologists registered after 1955. Post-1955 radiologists experienced a 32% lower SMR ($p<0.001$) for deaths from all causes than that of all physicians, and a SMR for non-cancer deaths that was 36% lower ($p<0.001$) than that of other physicians. The SMR for cancer was 29% lower (not significant) than that for all male physicians.

This demonstrates a highly significant beneficial effect of radiation at moderate doses of radiation. These doses were probably considerably higher than the background dose in most of the world, as occupational exposure limits for most of this period were 50 mSv year$^{-1}$, although the doses received by the radiologists are not known.

For the entire 100-year evaluation period, radiologists never had an elevated mortality rate from all causes compared with male physicians or the other two comparison groups. All radiologists registered from 1897 to 1997 had a non-cancer SMR that was 14% lower ($p<0.001$) than that of other physicians, while the SMR for all causes was 8% lower ($p<0.01$) than that of their male medical colleagues. During no time period was the mortality rate of radiologists from all causes higher than that of their medical colleagues.

The all-cause mortality rates of radiologists decreased significantly below those of all male...
physicians after 1955. Why would radiologists be healthier than other physicians? This suggests the hypothesis that the improved health of radiologists post 1955 was from stimulation of the immune system.

The Table 2 data yield a conclusion that a moderate increase of radiation is probably good for the health, yet the authors overlooked this convincing evidence for beneficial effects of radiation. The last sentence of the abstract states: “There was no evidence of an effect of radiation on diseases other than cancer even in the earliest radiologists.”

When the authors stated that there was no evidence of a radiation effect on non-cancer deaths for radiologists, it is apparent that they were thinking only of harmful effects of radiation. However, they did not indicate that they were only evaluating harmful effects. This leads to the error in the conclusions of the article, and suggests that the authors suffered from a perception that radiation cannot be beneficial to the health.

The concluding sentence of the article also omits any mention of benefits: “For non-cancer causes of death there was no evidence of an increased risk in any group, even among those registering before 1921.” This statement neglects to mention the significantly decreased SMR for non-cancer compared with other male medical practitioners.

If the early radiologists had no life shortening, one has to question the logic of the present very low annual recommended dose limit for radiation workers (20 mSv year⁻¹). This may be so low that it may reduce the health benefits seen in radiologists after 1935. It is possible that the first recommended dose limit of 0.2 R day⁻¹ (approximately 50 R (500 mSv) year⁻¹) for radiation workers set by the International Commission for Radiological Protection (ICRP) in 1934 did not need to be lowered, because all-cause and cancer mortality rates for radiologists registered in 1936 and later were significantly lower than those for the general public and were not significantly different than those for other physicians. Lauriston Taylor, one of the founders of the ICRP, wrote in 1980 “No one has been identifiably injured by radiation while working within the first numerical standards set first by the NCRP and then the ICRP in 1934. …. The theories about people being injured have still not led to the demonstration of injury and, if considered as facts by some, must only be looked upon as figments of the imagination.” [2].

The British radiologists study will not resolve the controversy regarding the validity of the linear non-threshold (LNT) model of radiation risk, but it casts doubt on the assumption that low levels of radiation have no beneficial effect on humans.

Scientists should be skeptical of a single study that produces unexpected results. However, a much larger cohort study of radiation workers, the US nuclear shipyard workers study (NSWS), demonstrated an equally dramatic beneficial result from exposure to occupational radiation [3]. The NSWS compared the health of 28 000 nuclear workers with the greatest cumulative doses with 32 500 age-matched and job-matched unexposed shipyard workers. The nuclear workers had a cancer death rate significantly lower (p<0.01) than the unexposed workers. More importantly, the death rate of the nuclear workers from all causes was 24% lower (p<10⁻¹⁶) than that of the unexposed controls. It is unfortunate that this important study has not yet been published 14 years after it was completed. I was a member of the Technical Advisory Panel of the NSWS, which consisted of eight outside scientists who met twice yearly from 1980–1988 to monitor the quality of the study.

The British radiology data show that moderate doses of radiation are beneficial rather than a risk to health. Data from the shipyard workers support this conclusion. The reduced mortality among exposed workers compared with an occupationally similar control group shown in both of these studies contradicts the present radiation protection dogma that radiation is a risk down to the lowest doses. Both studies give evidence that humans need a level of radiation above natural background in most areas of the world. There may be such a thing as radiation deficiency [4]. An optimal level may be similar to that received occupationally by post-1955 radiologists and by nuclear shipyard workers. Because of the mortality deficits seen among the British radiologists and the US shipyard workers, it would be ethical to conduct a double-blind radiation study on humans to resolve the important issue of health effects of low dose rate radiation [4].

J R CAMERON

2678 SW 14th Drive
Gainesville, FL 32608
USA

(Received 16 January 2002 and in revised form 27 March 2002, accepted 10 April 2002)

References

Decreased cancer mortality of British radiologists

The Editor—Sir,

The article “100 years of observation on British radiologists: mortality from cancer and other causes 1897–1997” [1] is, I am sure, welcomed by all those in the field, particularly those who have harboured some lingering doubt as to the safety of working a lifetime with low dose radiation. In the abstract the authors state that there was no evidence of an increase in cancer mortality among radiologists who first registered after 1954 in whom radiation exposures are likely to have been lower. Indeed, inspection of Table 2 confirms this. When we look at the entry for all cancers as a cause of death amongst those who first registered with a professional body between 1955 and 1979 we see that our standardized mortality is a meagre 0.46, which goes to say that aged-matched men are twice as likely to die of cancer as radiologists. When this is corrected for socioeconomic class the figure becomes 0.61, and when it is compared with all male medical practitioners it is 0.71, a remarkable reduction in the likelihood of dying from cancer amongst this group of workers in the radiation industry. The authors attribute this low death rate, at least in part, to the healthy worker effect.

The healthy worker effect, although accepted by health physicists and epidemiologists, is nevertheless a “catch-all” that is used irrespective of the extent or degree of benefit obtained within the workplace, to avoid invoking the other scientific conclusion, i.e. there is a benefit to be had, in this case, from low level radiation.

Although all would agree to a “healthy hire” effect, the extent of “benefit” seen in this review appears out of proportion. In any event, Baillargeon [2], in his excellent review of the healthy worker effect published in 2001, underlines that the healthy worker effect is usually substantially weaker for mortality from all cancers than for all causes of death, and he references no less than eight reviews to support that statement. As many of the readers of this journal will realize (although perhaps relatively few of the radiologists), there has been a healthy and acrimonious debate increasing over the last 20 years with respect to the veracity of the linear no-threshold hypothesis.

This paper is in line with many others in demonstrating a reduced standardized mortality rate for cancer amongst radiation workers, and it may be informative for the interested reader to refer to, for example, the occupational radiation exposure analysis from Canada by Sont et al [3], also published in 2001, to see another example of this reduction in standardized mortality. Now that we have plausible radiobiological evidence of (1) the beneficial effects of low level radiation on DNA function and repair and (2) the extraordinary low rate of radiation-induced DNA changes in comparison with those that occur in normal every day life — facts reviewed recently by Pollycove and Feinendegen [4, 5] — it is perhaps time for scientific honesty to be established in those that are strongly opposed to any alteration in the status quo with respect to the linear no-threshold hypothesis.

There is one more point to be made. A standardized mortality ratio of 0.71 for all cancers and 0.68 for all deaths compared with other medical practitioners (who presumably also registered with professional bodies) effectively excludes a health worker effect in this group (I’m sure other doctors don’t think of radiologists as being more healthy!).

I personally believe that the abstract and the discussion on this paper should go further than just saying that there was no evidence of an increase in cancer mortality among radiologists who first registered after 1954. The statement should carry on to say that there was a significant decrease in cancer mortality compared with a normal population as well as compared with medical practitioners and that, although this may to some extent be related to the healthy worker effect, a beneficial effect from low level radiation is not excluded.

N DAUNT

Queensland X-Ray
PO Box 109
Sunnybank
Queensland 4109
Australia

(Received 19 March 2002 and accepted 9 May 2002)

References
