Letter to the Editor

(*Concerning "Atomic bomb testing and its effects on global male to female ratios at birth" by Victor Grech, The International Journal of Risk and Safety in Medicine 27 (2015), 35–44. DOI: 10.3233/JRS-150641*)

Dear Editor,

The impact of radiation exposures from nuclear testing [1] and Chernobyl fallout [2, 3] on the male to female ratio at birth has been discussed by Victor Grech, professor at the Department of Pediatrics, Mater Dei Hospital, Malta. However, social factors that could have influenced this ratio were not comprehensively analyzed. The natural radiation background was not mentioned, although additional doses due to the contamination were often negligible compared to doses from the background. Worldwide annual exposures to natural radiation sources are generally expected to be in the range of 1–10 mSv, with 2.4 mSv being the estimate of the central value [4]. The six million residents of the contaminated territories of Belarus, Russia and Ukraine received average individual whole body doses around 9 mSv for the period 1986–2005. For the 98 million people in the three republics, the average dose was 1.3 mSv, a third of which was received in 1986. This is a minor addition to the dose from the global average background radiation for the same period, which is approximately 50 mSv [5]. In other countries, individual doses from the Chernobyl fallout were lower: the first year doses after the accident reached 1 mSv only at singular locations in Central Europe; all country overages were below 1 mSv [6]. The maximum annual dose from the global fallout was estimated to be 0.14 mSv in 1963, having decreased by almost an order of magnitude by 1979. Reported annual individual doses from a number of reactor sites have been in the range 0.001–0.5 mSv [4], so that these dose comparisons pertain also to the reported shift of sex ratios at birth in the vicinity of nuclear facilities [7]. For comparison, a single computed tomographic (CT) examination produces a dose within the range 2–20 mSv, while doses from interventional diagnostic procedures usually range from 5 to 70 mSv [8]. Health risks have never been proven for the above-mentioned doses; an overview is in [9].

Experimental and other relevant research has not been discussed in [1–3]. The following studies should be cited in this connection. Experiments using 18 generations of exposed mice with the daily dose ∼0.29 mGy suggested that low-dose low-rate exposures do not affect the sex ratio in mouse litters [10]. No radiation-induced sex ratio changes in the offspring of mice were found by other researchers [11–15]. On the contrary, a study and review from 1968 concluded that there is a sex ratio shift following spermatogonial exposure in rats [16]. It should be commented that doses used in animal experiments are higher than average doses to the residents of contaminated areas after the Chernobyl accident. These latter doses are generally within "the window for maximum adaptive response protection" [17]. According to experimental data, this window occurs at doses between 1 and 100 mGy from a low dose rate, low LET radiation exposure, where the risk is expected to be reduced below the spontaneous level of cancer risk [17]. Finally, data on the total number of births in Hiroshima and Nagasaki in the years 1956–1962 indicated no significant difference in the sex ratio in infants [18]. Significance of

supposedly radiation-related shifts of sex ratios calculated by Grech and co-workers [19, 20] has been questioned [21, 22].

The data and conclusions by Mr. Grech should be viewed taking into account possible mechanisms unrelated to radiation. So, except for the Baltic States, all regions of the former Soviet Union (SU) showed a significant increase in M/T ratio (male live births divided by total live births) from 1986 on [2]. The highest M/F (male/female) ratios at birth were reported from the South Caucasus (Azerbaijan, Armenia and Georgia) [2, 23], being explained by the son preference and sex-selective abortions [23]. The same might be true for the North Caucasus, where the birthrate has been the highest in Russian Federation [24]. High value is traditionally attached to masculinity in the Caucasus [25]. The elevation of the M/T and M/F ratios at birth coincided with the increasing availability of the prenatal ultrasonic gender testing in the late 1980 s [2, 23]. A relatively high M/T ratio at the time when prenatal gender testing of generally unavailable in the Caucasus (1981-85) [2] might be seen as indication to female neonaticide, the ancient family planning tool [25, 26], after home deliveries e.g. in mountainous areas with underdeveloped infrastructure. Gender imbalance due to the son preference and sex-selective abortions was reported from China, India, Vietnam and some neighboring countries [23, 25] as well as among Asian immigrants to Europe [27] and the USA [28]. On one hand, there are many migrants from the Caucasus in other post-Soviet States (except for the Baltic States mentioned above) and parts of Russian Federation, who bring with them their values and behavior patterns; on the other hand, the same tendencies of son preference might be present also in other groups of the ex-Soviet population favored by manliness propaganda perceivable since the early 2000 s [29]. Insufficient security coupled with the tolerant attitude towards trespasses of laws and regulations might have motivated some families to have sons – for protection and more success. All these social phenomena in the former SU coincided with the elevation of M/F or M/T ratios [2, 23]. Analogously, dynamics of M/T ratio in Western Europe [2, 3] could have been influenced by the ongoing immigration from countries with the a gender imbalance at birth [27].

1. Conclusion

The conclusions by Mr. Grech that "elevated levels of man-made ambient radiation may have reduced total births, affecting pregnancies carrying female pregnancies more than those carrying male pregnancies, thereby skewing M/T toward a higher male proportion" [1] and that "the M/T ratio is skewed upward significantly with population exposure to ionizing radiation, even at great distances from major nuclear events" [2] have not been satisfactorily proven. A significant role of radiation from nuclear testing and Chernobyl fallout as a factor modifying the male to female ratio at birth is improbable. If in doubt, it can be verified by large-scale experiments shielded from biases, using different mammal species, comparable radiation doses and dose rates.

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