



Relation between primary liver cancer occurrence and freshwater Cyanobacterial blooms in Serbia

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Since 1980 cyanobacterial blooms occurred in a large number of reservoirs, lakes and running water ecosystems (rivers and channels) in Serbia. Among 49 reservoirs examined, 32 were found in blooming condition almost every year during last 2 decades. All natural lakes and 12 river and channel localities in Vojvodina province (agricultural part) proved to be sites with cyanobacterial proliferation. The part of Central Serbia is very problematic for ground water supply. For that reason 21 reservoirs serve as drinking water suppliers. Significant and persistant cyanobacterial blooms have been recognized in 9 of them. Samples for cyanotoxin analyses were taken during and after blooms in Celije Reservoir and in drinking water in Krusevac town 2 days later. Concentrations of Microcystin-LR were $460 \mu\text{g}\cdot\text{L}^{-1}$ and for Microcystin-RR $170 \mu\text{g}\cdot\text{L}^{-1}$. Drinking water contained 2 and $0.6 \mu\text{g}\cdot\text{L}^{-1}$, respectively. Serbia consists of 30 administrative units, in three of which studies for Primary Liver Cancer (PLC) were conducted independently: Vojvodina, where drinking-water is supplied only from deep wells where 7 regions were studied, Kosovo with a few high mountain reservoirs for water supply without cyanobacterial proliferation where 6 regions were studied, and Central Serbia, where 17 regions were studied. Central Serbia showed 7 regions with extremely high PLC incidence and 8 regions with lower PLC incidence. In the two investigated periods, the high PLC mortality of 11.6 in 1980-1995 and extremely high PLC incidence of 26 in 2000 was observed in the regions affected by heavy cyanobacterial blooms. In contrast, the regions not affected by the blooms, PLC mortality and incidence rates were substantially lower: from 1980-1995 mortality rate amounted to 2.7 in Kosovo, 7.6 in Vojvodina, and 8.5 in the non-affected regions of Central Serbia, and in 2000 incidence rate amounted to 4.1 (Kosovo), 6.6 (Vojvodina), and 7.5 in the non-affected regions of Central Serbia. The uneven geographic distribution of liver cancer is conspicuous, and „hot spots“ could be related to drinking water supply. It is very clear that PLC high risk regions correspond with cyanobacterial blooming and PLC low risk regions correspond with water supplies not affected by cyanobacteria. PLC incidence in all regions not affected by cyanobacteria, i.e. Vojvodina, Kosovo and some regions in Central Serbia are in a similar range, whereas it is significantly higher in the affected regions of Central Serbia.