ESTIMATED WEEKLY INTAKE OF MERCURY THROUGH FISH CONSUMPTION IN SERBIAN POPULATION

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PROCENA NEDELJNOG UNOSA ŽIVE PREKO KONZUMIRANJA RIBE U SRPSKOJ POPULACIJI

Abstrakt
Zahvaljujući sadržaju visoko kvalitetnih proteina, vitamina, makro i mikroelemenata, kao i omega-3 polinezasićenih masnih kiselina, riba predstavlja značajnu namirnicu u ishrani ljudi. Međutim, povećanim unosom ribe unosi se i veća količina kontaminanata, posebno žive. Koncentracija žive određivana je u mišićnom tkivu riba koje imaju veliku zastupljenost u ishrani stanovništva Srbije – oslića, skuši, šaranu i pastrmci, kao i u proizvodima od tune. Svi ispitani uzorci sadrže živu ispod maksimalno dozvoljene količine regulisane evropskim i srpskim regulativama. Procenjeni nedeljni unos žive preko konzumirane ribe, ispod je preporučenog maksimalnog limita Svetske zdravstvene organizacije.

Ključne reči: *riba, živa, nedeljni unos*

INTRODUCTION

Fish has an important role in a healthy diet. It contains high-quality protein and other essential nutrients, is low in saturated fat, and contains omega-3 fatty acids. A well-balanced diet that includes a variety of fish and shellfish can contribute to heart health and children's proper growth and development. Fish however, bioaccumulate mercury and are the main source of human exposure to mercury. Accumulation of this substance in fish depends on age (size), fat composition and length of food chain. Mercury occurs naturally in the environment. It is released into the atmosphere naturally by degassing from the Earth's crust and oceans, and by human activities, primarily from burning household and industrial waste, and especially from fossil fuels such as coal.

Mercury vapor is easily transported in the atmosphere, deposited in soil and water, and then, partially released again into the atmosphere. Trace amounts of mercury are soluble in water, where bacteria can cause chemical changes that transform mercury to methyl mercury, a more toxic form. Fish absorb methyl mercury from water as it passes over their gills and as they feed on aquatic organisms. Larger predatory fish are exposed to higher levels of methyl mercury from their prey.

The nervous system is very sensitive to all forms of mercury. Methylmercury and metallic mercury vapors are more harmful than other forms, because larger quantities of mercury in these forms reach the brain. Exposure to high levels of mercury can cause permanent damage to the brain, kidneys, and developing fetus. Effects on brain functioning may result in irritability, tremors, changes in vision or hearing, and memory problems. Vomiting, diarrhea, increases in blood pressure or heart rate, skin rashes, and eye irritation can also occur. Young children are more sensitive to mercury than adults. Mercury in the mother’s body is transferred to the fetus and may accumulate there. It can also pass to a nursing infant through breast milk. Children poisoned by mercury may develop problems of their nervous and digestive systems, as well as kidney damage.

Adequate data on human cancer are currently unavailable for all forms of mercury. The U.S. EPA (United States Environmental Protection Agency) has determined that mercury chloride and methylmercury are possible human carcinogens (R i s h e r. and D eW o s k i n, 1999).

In Serbia, due to health benefits, fish consumption has increased and the aim of this work is to estimate the intake of mercury through fish consumption and compare it to the recommended safe limit.

MATERIALS AND METHODS

The weekly intake of Hg through fish consumption in Serbian population has been calculated by the deterministic model using fixed average values for consumption and mercury concentration. For consumption, we used data of the World Health Organization (GEMS/FOOD regional diets, 2003) for European – 46,8 grams per person per day for total fish and seafood intake (327, 6 g/person per week), which is similar to the recommendation of the American Heart Association of 340g/week. For the purpose of evaluating the health risk of this estimated dietary exposure, it was compared to the provisional tolerable weekly intake (PTWI) recommended by the Joint FAO/WHO Expert Committee for Food Additives - 5 μg mercury/kg body weight (WHO, 2003).

In 2008. total mercury concentrations were measured in the muscle tissue of four fish species of great importance in the diet of the Serbian population: two imported species - hake (*Merluccius merluccius*) and mackerel (*Scomber scombrus*) and two species farmed in Serbia’s fish ponds - carp (*Cyprinus carpio*) and trout (*Salmo irideus*). Also, mercury content was measured in canned tuna (*Thunnas spp.)* products.

Samples were prepared by microwave digestion (ETHOS Milestone). Sampled weight of fish muscle was 0,75g. Wet digestion was applied with 8mL nitric acid and 2mL hydrogen peroxide. Analyses were carried out on atomic absorption spectrometer Varian “SpectrAA 220” with VGA 77 hydride system. Cold vapor technique was applied, using 30% $SnCl_2$ as reductant. Analytical quality control was achieved by using certified reference material BCR 186. Replicate analyses were in the range of certified values.

RESULTS AND DISCUSSION

Mercury content in fish samples is presented in Table 1.

Table 1. Mercury content in fish samples.

species	number of samples	mercury content, μgg^{-1}		
		min	max	mean
hake	120	0,001	0,282	0,048
mackerel	32	0,009	0,116	0,042
carp	28	0,006	0,045	0,013
trout	25	0,008	0,059	0,018
canned tuna	110	0,008	1,148	0,106
total	315	0,001	1,148	0,045

All samples contained mercury below the maximum level fixed by the European Commission Decision (Commission regulation (EC) No 1881/2006, 2006) and Serbian national regulation (Pravilnik o količinama pesticida, 1992) wich set the maximum of mercury level at 0,5 μgg^{-1} for fish and 1,5 μgg^{-1} for canned tuna products. Mean mercury content in examined species is 0,045 μgg^{-1}. The highest average mercury concentration was found in canned tuna - 0,106 μgg^{-1} and the lowest in carp from fishponds - 0.013 μgg^{-1}. Mean mercury content in seafood – 0,065 μgg^{-1} was four times higher than mean mercury content in freshwater fish – 0,016 μgg^{-1}. Also, the weekly intake of mercury calculated on the basis of seafood intake was four times greather than the intake based on the freshwater fish consumption. Estimated average weekly intake of mercury through fish consumption based on the fish intake of 327,6 g/week for all examined species is 14,7 μg/week.

The average weekly intake of mercury in Serbia is similar to the mercury intake through fish consumption in Chile – 11,2 μg/week (M u n o z et al., 2005), and lower than the intake from fish in Spain – 92,4 μg/week (U r i e t a et al., 1996). Based on 70 kg body weight person, average weekly intake of mercury by all examined fish species in Serbia is 0,21 μg/kg b.w./week., and is lower than the estimated intake of mercury in Australia – 0,7 μg/kg b.w./week, France – 0,63 μg/kg b.w./week, New Zealand – 0,5 μg/kg b.w./week (W H O, 2004) and Italy – 0,66 – 3,23 μg/kg b.w./week (Storelli, 2005). In consumption scenario with the total seafood intake, the weekly intake of mercury is 0,3 μg/kg b.w./week, and in scenario with consumption of freshwater fish only, weekly intake of mercury is 0,07 μg/kg b.w./week. In the worst case, if the intake of mercury is calculated based solely on canned tuna consumption, the weekly intake of mercury is 0,5 μg/kg b.w./week. Estimated weekly intake of mercury through fish consumption in all consumption scenarios is lower than the recommended provisional tolerable weekly intake of 5μg/kg b.w./week.

CONCLUSION

Based on FAO/WHO recommended safe limit of 5 μg/kg b.w./week and on obtained results, we can conclude that the intake of mercury in the case of consuming imported hake, mackerel and canned tuna or domestically breeded carp and trout is lower than the safe limit.

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