

Musculoskeletal Changes in Yu-Cheng Children Compared with their Matched Controls.

Guo, Y.L.^A, Lin, C.J.^B, Yao, W.J.^C, Hsu, C.C.^D

^A Department of Environmental and Occupational Health, National Cheng Kung University Medical Center (NCKUMC), Tainan, Taiwan, R.O.C.

^B Department of Orthopedics, NCKUMC, Tainan, Taiwan, R.O.C.

^C Department of Nuclear Medicine, NCKUMC, Tainan, Taiwan, R.O.C.

^D Department of Psychiatry, NCKUMC, Tainan, Taiwan, R.O.C.

In 1978-9, there was a mass poisoning in central Taiwan that was traced to the contamination of rice bran cooking oil by thermally degraded polychlorinated biphenyls (PCBs). About 2000 persons had an illness characterized by hyperpigmentation, acne, peripheral neuropathy, and other signs and symptoms. The disorder was called Yu-Cheng, "oil disease," in Taiwan¹, and it was similar to a Japanese outbreak that had occurred in 1968. PCBs are industrial insulating chemicals that have been a worldwide pollution problem since at least the mid 1960's; they have been found in trace amounts in the fat tissue of human beings throughout the industrialized world². The main route of exposure is probably through low-level contamination of food, and, once in the body, PCBs accumulate and are not well excreted. PCBs are toxic, very bioactive compounds themselves; however, in both of the Asian outbreaks, the PCBs were in turn contaminated by polychlorinated dibenzofurans^{3,4} (PCDFs). These have qualitatively similar toxicities, but some are extremely toxic with potencies approaching 2,3,7,8-tetrachlorodibenzodioxin⁵.

In early 1985, we identified all living children born to women in the PCB registry maintained by the health departments responsible for the care of the Yu-Cheng cohort. There were 128 such Yu-Cheng children born to 74 mothers⁶. One hundred and fifteen Yu-Cheng children born to 69 mothers and 115 matched control children were followed after parents' written permission since then. These controls were matched for neighborhood, age (within 15 days for those under one year, and within one month for those older), sex, mother's age (within 3 years), parents' combined educational level (within about 3 years for the total) and occupation (within one class of five classes from unskilled laborer to professional).

In February 1991, we invited the Yu-Cheng children and their controls to come to National Cheng Kung University Hospital for examination. Fifty six Yu-Cheng children and matched unexposed controls (Table 1) appeared and were examined on their growth profile and

Table 1. Characteristics of Yu-Cheng children and their controls as of March 1, 1990. There is no significant difference between these two groups.

Group	Yu-Cheng	Control
Mean age (years)	8.55 ± 2.01	8.55 ± 2.02
Sex (M/F)	26/30	26/30

structures of the joints. Dual-photon absorptiometry (DPA) was performed to measure bone mineral density and soft tissue content for 25 randomly selected pairs of Yu-Cheng children and controls. Joint structure was assessed by examination of joint laxity. Two scoring systems were used. The total laxity scores, allocating points for six simple maneuvers including the laxity of thumb, 5th metacarpophalangeal (MCP) joint, elbow, knee, spine, and foot, range from 22 to 72 points^{7,8}. The Beighton's joint laxity scores, evaluating the laxity of 5th MCP joint, thumb, elbow, knee, and trunk, range from 0 to 9 points⁹. Bone mineral density and soft tissue compositions were measured by a LUNAR DP4 dual photon absorptiometry¹⁰. Bone density was measured for head, arms, legs, trunk, ribs, pelvis, spine, thorax, and lumbar spines separately. Body content of soft tissue, fat, and lean mass were measured as a total.

The Yu-Cheng children were shorter in height compared to their controls by 2.8 cm (Table 2). There was no difference in the weight, joint laxity (Table 2) and total bone mineral density (Table 3) between Yu-Cheng and control groups. The total lean mass and soft tissue content were significantly lower in Yu-Cheng children (Table 4). The shorter stature, decreased total lean mass and soft tissue content were seen only in the first children born after PCB intoxication, but not in later-born children (Table 5).

Table 2. Physical findings in 56 Yu-Cheng children and their controls. The difference between Yu-Cheng children and their controls was compared by paired T-test.

	Yu-Cheng children	Controls	Mean of difference (Yu-Cheng minus control)	p-Value
Height (cm)	129.4 ± 12.9	132.1 ± 13.8	-2.8	.014
Weight (Kg)	29.65 ± 9.60	29.98 ± 9.95	-.067	n.s.*
Total joint laxity score	44.8 ± 7.5	45.2 ± 6.7	-.4	n.s.
Beighton's joint laxity score	6.1 ± 2.4	6.0 ± 2.1	.018	n.s.

*: not significant statistically

Table 3. Bone mineral density by DPA in 25 Yu-Cheng children and their controls. The difference between Yu-Cheng children and their controls was compared by paired T-test.

	Yu-Cheng children	Controls	Mean of difference (Yu-Cheng minus control)	p-Value
Head	1.37 ± .174	1.34 ± .154	.029	n.s.
Arms	.56 ± .059	.56 ± .065	-.001	n.s.
Legs	.75 ± .129	.74 ± .120	.011	n.s.
Trunk	.65 ± .073	.64 ± .075	.008	n.s.
Ribs	.55 ± .037	.55 ± .049	.002	n.s.
Pelvis	.74 ± .109	.73 ± .105	.013	n.s.
Spine	.66 ± .106	.65 ± .095	.011	n.s.
Dorsal	.63 ± .096	.62 ± .096	.012	n.s.
Lumbar	.70 ± .140	.70 ± .113	.006	n.s.
Total	.82 ± .067	.81 ± .068	.010	n.s.

Table 4. Soft tissue content by DPA in 25 Yu-Cheng children and their controls. The difference between Yu-Cheng children and their controls was compared by paired T-test.

	Yu-Cheng children	Controls	Mean of difference (Yu-Cheng minus control)	p-Value
Total soft tissue mass	26542 ± 8522	30318 ± 10108	-3776	.043
Total body fat	6599 ± 4438	8302 ± 5024	-1703	n.s.
Body fat (%)	23.2 ± 7.2%	26.3 ± 9.9%	-3.1%	n.s.
Total lean tissue mass	19944 ± 4775	22017 ± 7126	-2073	.015

Table 5. Soft tissue and lean mass contents by DPA in Yu-Cheng children and controls. The Yu-Cheng children were divided into two groups, i.e., the first children born after mothers' intoxication and those born later.

	Yu-Cheng child's Birth order after intoxication	N	Yu-Cheng children	Controls	Mean of difference (Yu- Cheng minus control)	p-Value
Total soft tissue mass	1	14	28675 ± 9304	33962 ± 10915	-5287	.062
	2 or later	11	23828 ± 6877	25682 ± 2091	-1853	n.s.
Total lean tissue mass	1	14	21266 ± 5209	24148 ± 8223	-2882	.043
	2 or later	11	18262 ± 3727	19305 ± 4419	-1043	n.s.

The authors concluded that the height, total lean mass, and soft tissue content were affected in the children prenatally exposed to thermally degraded PCBs up to the age of ten. The differences between exposed and unexposed groups were detectable only for the first child born after intoxication, likely due to less intrauterine exposure to the contaminants in the later-born children.

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