Starvation Osteoporosis in Shoah Survivors: Emphasis on Descendant Generations

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"It is the shame of the 20th century, that some 75 million people died of hunger, despite sufficient food supply."

S Devereux [1]

The concept of *Starvation Osteopathy* is an old and an investigated one, which is well established in many ways. Studies were conducted on famine survivors during World War I, in the Ukraine in the early 1930s, throughout Europe during World War II, and in Asia and Africa soon after. However, the main topic of this article is the effect of starvation inflicted during the Holocaust.

The Shoah syndrome included psychiatric aspects of the survivors as well as cardiovascular and (glucose and lipid) metabolic aspects. [2]. In previous research the presence of osteoporosis in Holocaust survivors was also emphasized [3,4]. This study concentrates on the presence of the same pathology in the children and grandchildren of survivors. The observations were intended to show the similarities of symptoms within dispersed survivors around the world, on the gender factor in incidence, and in the transmission to descendants.

THE GLOBAL ASPECT

The effect of starvation on bone mineral metabolism in the immediate, early, and late post-Shoah periods were late to emerge. Indeed, even later were the investigations into the descendants in their families. It is this aspect that prompted a review of many survivors. In this article, I present my findings and classify the disease. Nutrition as a cause of bone metabolic aberration was first raised by Cooper and colleagues [5] at the British Southampton clinic. Their investigations focused mainly on WWII survivors and their families. Their research expanded on the earlier studies by Barker [6] and Lucas [7] on pathologies emerging from early life starvation [5-12].

The studies on bone pathology of Shoah survivors and descendant families included cases from Australia, North America, South America, Europe, and Israel. The results were common to all the dispersed persons, suggesting the effect of the Shoah persisted despite re-nutrition of survivors and despite normal nutrition within the following generations [13-15].

STARVATION OSTEOPATHY

Extensive interviews with cooperating survivors and families were conducted via an organization of Shoah survivors based in Sydney, Australia. Interviews were held at the Sydney Jewish Museum and at Sydney University as well as via online interviews, phone calls, Skype discussions, correspondence with offices of previous concentration camps (e.g., Dachau, Buchenwald, Terezin, Auschwitz, Bergen, Ravensbruck), and face-to-face meetings. The information, although significant, was not appropriate for an epidemiological or statistical study, but rather for clinical observations only. The people included in this study were either survivors themselves or descendants. A total of 85 cases, from a group of 132 initial interviews, were included. Only well documented data were accepted, and anecdotal details were excluded.

The classification of *Starvation Osteopathy* was in accord with the stage of skeletal development at the time of nutritional deprivation. *Primary Osteopathy* was considered premature in cases such as during pregnancy or childhood, with undeveloped or incompletely developed skeleton. The adolescent or adult cases, with established skeletons, were considered *Secondary Osteopathy;* whereas cases in subsequent generations were considered as *Inherited Osteopathy.*

Cases were assessed for osteoporosis based on Sydney's Garvan Fracture Risk Calculator, an algorithm that includes clinical signs (falls, fractures, and age) and *t*-score and *z*-score densitometer (DEXA) readings [16,17]. The *t*-scores were calculated from DEXA scans of the lumbar spine and the neck of each femur. The *z*-scores were mainly the deviation from the average [Figure 1]. The results obtained from Garvan tests were compared with the Sheffield FRAX test [17].

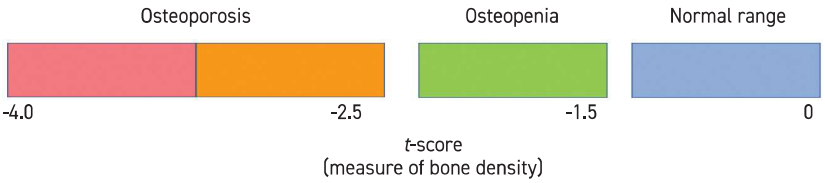
FAMILY CASES

Anonymity was assured for the interviewees. Initials or false names were used for identification.

Family case 1

While being treated for a fractured pelvis at age 90 years, the mother recounted her Shoah experience. With her husband, she escaped from a Slovakian city and went into hiding in the Carpathian Mountains, where they lived for close to one year in a deserted shack. The food supply during the entire period of hiding was provided every two weeks by a former foreman who had taken over the factory. The mother recovered from semi-starvation, with an unviable pregnancy of 3–4 months. In Sydney, she was diagnosed with severe osteoporosis and repeated fractures. Her daughter, who was born after the war, grew up with normal nutrition, but had borderline osteoporosis by age 48 years. The mother's bone density was -4.0 (*t*-score) / -1.5 (*z*-score). The daughter's bone density was -2.3 (*t*-score) / -0.8 (*z*-score). The diagnosis was Secondary Osteopathy for the mother, with extensive bone metabolic deficiency. More important was the effect on the embryo/fetus during first/second trimester. The likely insufficient or inexistent levels of vitamin K2 led to intrauterine cerebral bleeding and miscarriage of the embryo. The family's diet consisted solely of corn, which is a carbohydrate diet devoid of essentials. The nutritional values obtained for corn indicates satisfactory survival for a restricted period (85 gram of fat: 9 calories from fat, total saturated fat = 1 gram; cholesterol = 0; sodium = 9; potassium = 165 mg; carbohydrate = 19 grams; fiber = 2 grams; sugar = 4 grams; protein = 3 grams; vitamin A 4%; vitamin C = 8%; iron = 2%; calcium = 0 (Certified Health information, USA, May 2018) [18] The mother was diagnosed with *Secondary Osteopathy*, and the daughter with *Inherited Osteopathy.*

Figure 1. DEXA graded bone density



Family case 2

The baby was born in Auschwitz on the 27 January 1945, weighing 1.8 kg and fed by another mother. There is no data on the mother, but the baby grew to be 141 cm. tall. He is living in Hungary. He recovered from severe spinal stenosis with myelomalacia. In parallel, he was diagnosed with bone density of -2.54 (*t*-score) / -1.55 (*z*-score). He developed post-spinal decompression and became mobile at age 66 years. The diagnosis was a clear case of a male, embryonic *Primary Osteopathy.*

Family case 3

The mother was interred in the Budapest ghetto while 5 months pregnant, living with a son aged 4 years and a daughter aged 2 years. The food supply was both qualitatively and quantitatively insufficient. The mother gave birth 2 months after liberation. The family survived and emigrated to Australia. The newborn was diagnosed with a case of Primary Osteopathy, with a *t*-score of -2.9 at the age of 46 years and a *z*-score of -1.5.

Family case 4

DW was born in 1926. He was aged 13 years when WWII reached Poland. He escaped from the Lwów Ghetto in Poland and wandered in the countryside for 3.5 years. He was found in a semi-conscious state and hidden in Warsaw. He was revived and gradually fed. He reached the normal height of 163 cm, finished high school with distinction, and planned to study medicine. At age 27 years, after a light fall while living in Jerusalem, he presented with a fractured base of the neck of the femur, typical of old age. He was treated with the insertion of a pin, and despite a thin bony cortex, visible on plain X-ray, the fracture united. He presented further with rib fractures from coughing events during recurrent bronchitis infections. Three children were born and raised in Rehovot, Israel: a daughter diagnosed at age 48 years with osteoporosis; second daughter diagnosed with osteopenia at the age of 46 years, a son aged 45 years, with normal bone densitometry, but close to osteopenia. No data about the mother was available. The father presented with a case of *Secondary Osteopathy*, and the daughters were diagnosed with *inherited Osteopathy* [19]. The father had a *t*-score -4.4 and a diagnosis of *Secondary Osteopathy.* The daughters had *t*-scores -3.1 and -2.2, with a diagnosis of *Inherited Osteopathy.*

Family case 5

A pregnant woman was incarcerated in the Budapest ghetto and was exposed to severe nutritional deprivation. She delivered a premature baby weighing only 1.5 kg. The newborn

was incubated at the end of the war for 4 months until reaching a satisfactory weight. The mother regained her health and eventually moved to Australia. She had a bone density score of -1.46 (*t*-score) / - 0.46 (*z*-score). However, her son was diagnosed with metabolic syndrome, myocardial ischemia at age 39 years, and bone densitometry at age 40 years -1.57 (*t*-score) / - 0.8 (*z*-score). The son showed a tendency toward ostepoenia, *Primary Osteopathy.*

Family case 6

A Hungarian Jewish woman was incarcerated first in a local country labor camp (Tungsram) and subsequently transferred to Ravensbruck concentration camp. She was ordered to perform hard labor and subjected to severe nutritional deprivation. She survived and returned to Budapest. Soon, she started a family and eventually emigrated to Australia where she lived till age 94 years. During her lifetime she sustained several fractures and was found to have a *t*-score of -4.4. She had three daughters who were in good general health but had bone density *t*-scores of -1.7, -1.5, and -3.3, respectively. The most intriguing observation was the daughter of the third daughter. This granddaughter was in good health, but at the age of 43 years, she had a *t*-score of -2.5. The mother presented with a case of *Secondary Osteopathy.* The third daughter and her own daughter, that is, the granddaughter, were diagnosed with Inherited Osteopathy.

Family case 7

A Romanian Jewish family was deported to Transnistria, a Ukrainian camp. The grandmother survived and settled in Haifa. Her daughter had a normal reproductive life. She became a grandmother, and was found to have severe osteoporosis, *t* -3.4. Her daughter had a *t*-score of -2.1 and the two granddaughters were diagnosed with osteopenia and osteoporosis, both with retained menstrual cycle, but with bone density measuring *t* = -1.95 and *t* = -2.6, respectively. The grandmother was diagnosed with Secondary Osteopathy, and the two granddaughters with Inherited Osteopathy.

Family case 8

Two brothers survived in the Polish country site, in their late 20s and early 30s, respectively. They were hidden for 22 months, while fed mostly with turnips. The turnip cubes, (weighing about 156 grams) contain 34 calories, 1.11 grams of protein, 0.12 grams of fat, 7.89 grams of carbohydrate, (including 4.66 grams of sugar), 3.1 grams of fiber, 51 milligrams of calcium, 0.28 mg of iron, 14 mg of magnesium, 41 mg of phosphorus, 276 mg of vitamin K, 25 mg of sodium, 0.19 mg of zinc, 18.1 mg of vitamin C, 14 micrograms (mcg) of folate, vitamin C, manganese, potassium, vitamin B-6, and copper [18]. Post-war they emigrated to Australia and established families. The younger brother was physically very strong, with no illnesses or fractures recorded, and he lived until his late 80s. The surprise was the family of the younger brother: The mother was born in 1917 and died in Melbourne, Australia, in 1984, with no reported fractures. She was incarcerated in Auschwitz for 8 months. The daughter was recently assessed. She was born in a displaced person's camp in Europe in 1947, and grew up in Australia with no fractures recorded. At the age of 70 she was diagnosed with bone densitometry *t*-score of -5.1 and *z*-score of -3.1 at lumbar spine level and of *t*-score of -3.3 and *z*-score of-1.5 at the hip level. She was diagnosed with *Inherited Osteopathy.*

DISCUSSION

Observational studies in accordance with PubMed definitions are accepted as valid in searching for the etiology of diseases. At times, studies with no control are at risk of criticism, as is the present one, being even more at-risk for being retrospective study by many years.

Nonetheless, they have analytical value by identifying possible etiological factors for health conditions such as osteoporosis. This observational study presents facts and offers etiology for osteoporosis. Many contradictions can be found and there are many limitations, However, the general impression remains valid on the survivors no matter where they lived.

There was no verification of the mechanism of the pathogenesis [20,21]. Etiological explanations for osteoporosis were missing during several famine-inflicted historical periods of the 20th century. The exception was the explanation given in Ghetto Warsaw as part of the Famine Disease.

This review follows the thesis of osteomalacia and osteoporosis at the Czyste Hospital in Warsaw from 1941 to 1943. It described the lack of bone healing in children and explained the subsequent abandonment of metallic bone fixation. The medical reports offered clinical, laboratory, and histological proof [21].

As indicated by previous research, starvation could affect osteogenesis in both directions [11,12]. Indeed, changes of excessive bone formation and spinal abnormalities were found in famine victims. However, most changes were toward negative metabolic directions, and osteoporosis is the one reviewed in Shoah survivors.

The review findings suggest starvation or sub-nutrition as the likely

pathogenesis and suggests epigenesis as the mechanism of inheritance for the descendants [20-24]. Of great interest was the observation of the same symptoms and findings in survivors dispersed around the globe [20].

Details were collected via internet services. Objective signs were collected from families in Montreal, New York, Baltimore, Minnesota, San Francisco, Los Angeles, Sao Paolo, Melbourne, Brisbane, Newcastle, and Sydney. All data were either similar or identical. These details were similar to data on families from the Israeli cities of Kiryat Chaim, Petah Tikvah, Kiryat Ono, Rehovot, as well as from Rambam Health Care Campus and from Hadassah Hospital. Strange, but not different were, data supplied by various Eastern European countries. The objective signs were incorporated in this review.

All interviews strictly observed the ethical requirements.

Final observations

Bone metabolism changes of various intensities were found equally dispersed in Shoah survivors around the world, far away from the site of the European crime. The presence of metabolic bone changes of varying intensity, osteopenic, or osteoporotic, was confirmed in both genders of survivors. The inheritance within the following generations was observed in both genders and was transmitted by both parents. The mechanism of transmission was suggested earlier but could be only proven by a large epidemiological study undertaken within Israeli populations or within populations exposed to famine around the globe [24]. It is to prevent repeating the shame of the 20th century.

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When you counsel someone, you should appear to be reminding him of something he had forgotten, not of the light he was unable to see.
Baltasar Gracián y Morales, SJ, better known as Baltasar Gracián (1601–1658), Spanish Jesuit and baroque prose writer and philosopher