

New Ways to Investigate Contamination and Human Health

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I want to thank the organizers for allowing me to come today and I am grateful for everyone who came out to hear my presentation. I am an anthropologist. My work is very different than what you have been hearing. I will report on a six year study on pesticide affected communities. I decided to look at communities to determine if one could determine if a community is at risk versus the individual risk. I started with looking at children, evaluating the level of health, not the incidence of disease, and ending up with a picture of a community, not of the individual person. This has become a longitudinal study involving many of the same children, covering a period of six years.

This work occurs in the Yaqui Valley, which is in Sonora Mexico, and located about 500 km south of New Mexico, USA. There are 3 communities in the agricultural valley and one in the foothills, which differs from the valley towns in terms of pesticide use. During the green revolution, the Native Americans living in the valley had a philosophical division. Some wanted to retain the old lifestyle, others wanted to move into modern agriculture, including the use of pesticides, tractors and irrigation. The Native Americans wanting agricultural modernization remained in the valley and established towns. I can tell the history of the pesticides used in agriculture by visiting the pesticide dump. What is found there is very similar, or the same, as the pesticides being used in the United States. Over the years I have seen the same progression from organochlorines and organophosphates up to the very modern pesticides.

The group that did not want to get involved with the pesticide movement moved to a town in the valley foothills. These people continue with traditional ranching, traditional home gardens, and no use of pesticides. While the families in the valley itself spray homes almost daily with pesticides, no home spraying occurs in the foothills. All the involved towns have the same infrastructure, school and health systems, and have the same gene pool and dietary practices. So, the big difference is in pesticide use. In terms of analysis, one group is referred to as pesticide exposed or valley children, the other are lesser exposed or foothill children.

The study began with children ages 4 to 5 years and has progressed with the same children and others to ages 8 to 10. No significant differences between the groups could ever been seen with a casual glance. Over the years, there has been no significant differences in terms of height, weight and head circumference measurements, indicating that undernutrition is not playing a major role in the endpoints.

In order to determine if pesticides may be impacting the lives of the assumingly normal valley children, I devised a series of activities representative of developmental stages and segments of intelligence tests. The sessions with the 4-5 year old children began with catching a ball, measuring how often they could catch a ball at different distances. The ability of the exposed children to catch a small ball at three meters was significantly lower than that of the lesser-exposed foothill children. This indicates poor eye-hand coordination. Balance was also measured. Children at age 6 and 7 years, walked on a plank measuring approximately two inches across. The lesser-exposed foothills children could walk the plank, turn around, and come back without falling off. A few of the children in the valley fell off before reaching the turn-around point, and many lacked the balance to turn around and return. Most of those who were able to turn around fell off the plank before the end.

The exercises to determine stamina levels depended on the age, whether they were 4-5 or 6-7 years. We played games indicating how much energy they could expend. Jumping contests were held when the children were 4 -5 years, measuring the times they could jump before quitting. At ages 6-7 years, games of tag were played, measuring the time before they had to stop to catch their breath. With all ages, the

exposed children could exercise approximately 45 seconds before reaching a heart rate of 120-130, compared to the lesser-exposed children who would jump or run 3 to 5 minutes before reaching their maximum heart rate. These findings are representative of the physical neuromuscular abilities which may be affected by pesticides.

Let us look at differences in mental abilities. Before playing with the individual, I would say "I am going to give you a colored balloon when we are finished". The color was pointed out on a near by object. At the end of the play exercises, which took 30 minutes, the child was asked to name their gift and the color. With the lesser exposed 4-5 year olds, well over half (58.8%) remembered the balloon and the color. All the others could name the gift. In contrast, with the exposed children, a little more than a quarter could remember both the color and balloon, and 18.2% could not even remember they were getting a gift.

Problem solving abilities were measured with the 6-7 year olds. The children were asked to replicate a card drawing by using four to six blocks consisting of two sizes. When they were finished, they were given the opportunity to say if their design was correct or not. If the child thought their design was not identical to the drawing, a correction could be made. The children who were lesser exposed worked rapidly. Very few of them made a mistake, always recognized a mistake and made the necessary corrections. In contrast, the exposed children had great difficulty in making the design. The replication of the design often involved building upward tiers to obtain the correct shape. Some, when I asked if the design was correct or not, would look up with a big smile and say, "I did it right". These exposed children did not recognize the fact that they are making errors in problem solving.

Large differences in abilities were demonstrated when children were asked to draw a stick figure. The foothills children, ages 4 and 5, made fairly complete figures recognizable as a person. In contrast, the exposed children, of the same ages, would draw squiggles or meaningless lines. Those few who drew what could be a somewhat recognizable picture started at the bottom and drew upside down, limiting the drawing to a circle and an upward line. At ages 6-7, after 1 to 2 years of school, the exposed children were drawing on a level that was barely that of the lesser exposed 4 year olds.

We hear a lot about contamination impacting the immune system. When mothers were asked about disease incidence, the majority of the foothills children had an illness rate of zero to two times over the previous three month period. In contrast, the rate of illness for the majority of exposed children was five to six times, followed by illness rates of 7 to 8 occurrences. For these children, symptoms reflected infectious diseases, particularly upper respiratory infection. Sore throat may occur once in a lesser exposed child but the valley child would experience three or more sore throats.

We are also hearing a lot about the impact of contamination on reproduction. The following research centered on the same children, using pre-puberty girls ages eight to ten. Again, with the girls there are no overall significant differences in any of their measurements, including height and weight but the amount of variation in measurements was greater with the exposed girls. Pre-puberty for females is usually measured in terms of stages in breast development based on the Tanner Scales. Stage 1 involves a breast bud, where the nipple enlarges with breast development absent. The following stages reflect increasing degrees of breast development until full growth is achieved. Tanner Scale placement for the individual under study was determined independently by two researchers with full agreement. There was no correlation between body weight and the Tanner stage of breast development in either the valley or foothill girls.

As described, breast growth has always been determined by observation. In this study, I palpated the breast to determine the amount of mammary tissue in relationship to fat tissue. Mammary tissue is firm, compared to the softer fatty tissues also contained in the breast. The ratio of total breast diameter to mammary tissue diameter was calculated. A direct correlation between breast size and mammary tissue was found with the foothill children. The exposed children exhibited no relationship in this ratio. Five of

the 30 girls examined exhibited moderate (stage 3) breast development but no mammary gland could be palpated, with another five (Stages 2 and 3) having an extremely small amount of mammary tissue compared to the total breast size.

Mental changes are associated with puberty. The girls were asked to reply to questions regarding boys and perceptions of self. When they were asked what they liked about boys, the majority of valley girls replied that they liked them when boys paid attention to them. In contrast the foothill girls liked boys because they let them play street games together. Valley girls said there dislikes about a boy involved his self-centered attitudes and teasing. The lesser-exposed girls did not like boys when they fight one another. In regards to concerns about self, the valley girls worried about their dress, how one looks, and the shape of her body. Emphasis was on body image in contrast to the foothills, where the girls' major concern was doing well at school, being a good girl, and helping at home.

Any research raises new questions. I still have a lot of questions not only about the growth and development of these supposedly normal, but pesticide exposed children. When you walk in the villages they overtly appear to be healthy children. I also have increased questions about the development during puberty for both females and males. These towns have a population of roughly 800. The physicians of the valley towns are describing to me what they have named "pre-puberty obesity in boys". In each town, approximately eight to ten boys, ages 8-10, are developing female fat patterns and breasts with mammary tissue. Mammary tissue in boys is painful with touch. This is something that really should be investigated. The same fat patterns with mammary growth has been reported to me by physicians in India, Columbia and Puerto Rico.

In terms of my work, I have been building on current and proven damage due to contamination that is being found in the laboratory and in wildlife. Such knowledge should be applied to humans. Endocrine disrupting contamination should be thought of as an iceberg: with only a small amount of the ice above the surface of the water. In terms of contamination, there is a limited amount that we recognize and more that we suspect to be true, but without definitive proof. Like the iceberg under water, there is so much left to be recognized or appear as a problem, and probably, for the most part, we will never recognize all the impacts of contamination. This work that is being done here this week, this year, and in the coming times, is so important. Goals can be accomplished with good communication between laboratory, wildlife scientists and social scientists. Then, we can go out and know what to look for in our populations and discover more of that 'hidden iceberg'. We cannot forget that the future of any country is determined by the quality of its children and the environment they live in. Thank you.

Q&A

Toppari: Thank you for this new aspect of the topic. Now we have a lot of time for discussion.

Tsunoda: I am a pediatrician from Miyazaki Prefecture. Of course pesticides are used in agricultural areas. Even in ordinary gardens in the towns people use pesticides, especially an insecticide called fenitrothion anywhere from once to several times a year. In some areas they dust it to control pine beetles, which causes children to become ill. We must tell children who have become ill how they can avoid being harmed, but unfortunately there appears to be no way to avoid it. The only way to avoid it would be to go grandparent's home and stay there about a week. You might know about lifestyles in such areas and the difference between children who are affected by pesticides and those who tend not to be. If you know some way to avoid this, I would appreciate if you could tell us.

Guillette: The type of situation explained is very difficult to solve because people are tied to where they live economically and socially. I work with the people in Mexico to eliminate as much exposure as possible. This includes spraying of the houses, which has dropped from daily to once every 2 weeks, I am very proud of that.

So the people are taking responsibility for decreasing their own exposure. They also will go in their house during overhead spraying and close the windows and doors. I recommend proper washing of clothes. If pesticides get on the clothes they should be washed separately from all other clothes and the water discarded before anything else is put into it. So it is the small steps that are going to decrease their exposure until you work on policy change to stop the overhead spraying. Does that answer your question?

Toppari: There is another question.

Matsuzaki: I read about the hard work you are doing several years ago, and I really respect you for that. Today I saw some new information for the first time and was shocked by it. Although you said you do not study illnesses, but foothill children are infected by something and become ill immediately after birth and eventually become healthy right away. I was shocked by the graph that shows valley children however do not become ill at first but then gradually become ill. I say this because valley children use pesticides in their homes as well as in the fields. I think this may indicate that because of absence of bacteria and viruses that should normally infect the surrounding area, the children are not infected at first, so they do not develop immunity. Have you discussed this with immunologists?

Guillette: The infection rates that I presented, and I do not know if you misinterpreted them, was the number of times the child had an infection over a 3-month period. This data was gathered when they were in school.

In terms of early infection, parents are reporting that these children have always had infections, a high illness rate. The clinics also report chronic illness with the valley children. So it is not a matter of not being exposed early in life and then suddenly being exposed. Does that answer your question, or did I misinterpret what you are asking?

Matsuzaki: I hear a lot about the immunity and the process of children being infected and developing immunity after birth, and that means there is no biological correspondence among bacteria, viruses, as roundworm and parasites in the ecosystem in areas where lots of pesticides are used. Thus I interpret from your graph the possibility that the process of children being infected and developing immunity is absent may result in them getting sick after going to school. I think this is an important result of your study.

Guillette: No, I have not discussed this with an immunologist. I have discussed it with clinic physicians and nurses in the area. These are people living in towns surrounded by agricultural fields; they are exposed to insecticides and herbicides. No one that I know of has looked at the actual incidence of pathogenic bacteria, for instance.

The immune system may have been compromised very early in life by these children, because they were the third generation children. Their mothers or grandmothers had been exposed to these chemicals, so they had *in utero* exposure. The

other thing that I did not bring out is that many of them are showing signs of autoimmune disease, which is kind of the opposite or also tied in with the immune system but works in a different way, of increased allergies, increased rashes and so forth.

So my feeling is the immune system is compromised. It is not a matter of suddenly being exposed to pathogens that were not present when they were younger children.

Toppari: Thank you.