What is the Relationship Between Repeated Pesticide Exposure and Neurological Disease in Adult Farmers?
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**Background**
- In 2007, the U.S. accounted for 32% of the world’s total pesticide expenditures; 38% herbicides, 39% insecticides, 15% fungicides, and 25% pesticides (Grube, Donaldson, Kiely, & Wu, 2011).
- During 2006-2007, the U.S. produced over 9.8 billion pounds domestic pesticide, 1.6 billion imports, 2.1 billion exports (Grube, et al, 2011).
- Pesticide exposure enters the body dermally, orally, or by inhalation or respiration (Ogg, Hygnstrom, Bauer, & Hanson, 2012).
- Exposure can be acute or chronic.
- In 2010, the poison control center received 91,940 reported pesticide exposures (Ogg, et al, 2012).
- Pesticide exposure accounts for 6% of adult accidental poisonings (Ogg, et al, 2012).

**Method**
- Ganong’s method (1987) was implemented for the integrative literature review.
- Research articles were obtained from the OVID database.
- A literature research was conducted using the key words: pesticides, farmers, exposure, neurological, farmworkers, and organophosphate.
- Inclusion criteria: Research articles, published in English, limited to United States, and peer reviewed journal.
- Exclusion criteria: Non-research articles, not in English, outside the United States, and non-peer reviewed journal.
- Total of seven articles meet the criteria.
- The Health Belief Model was applied (Rosenstock, 1974):
  - Perceived susceptibility – exposure to pesticides
  - Perceived severity – neurological disease
  - Perceived benefits – healthy, safe
  - Perceived barriers – cost, time, knowledge
  - Cues to action – use of Personal Protective Equipment (PPE) to prevent the development of neurological diseases.

**Synthesis of Literature**

<table>
<thead>
<tr>
<th>Authors</th>
<th>Findings</th>
<th>Limitations</th>
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<td>Beseler et al. (2003)</td>
<td>• Pesticide poisoning decreases concentration of excitatory amino acids in the brain.</td>
<td>• Undetermined if farmers were exposed to pesticide due to poor safety practices or if the exposure to pesticide lead to poor safety practices.</td>
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| Hayden et al. (2010) | • Cox proportional hazards model shows an increased risk for dementia. | • Reliability of the self-reporting.  
• Exposure chemicals may have been misclassified. |
| Horowitz (1999)     | • Reduced sensation in the lower extremities.                           | • Inaccurate screening techniques for peripheral neurologic deficits.       |
| Jamal et al. (2002) | • Among farmers who dipped sheep, 18% reported neuropathy compared to 5% of the general population. | • Small amount of the study.                                               |
| Pilkington et al. (2001) | • 19% of sheep dippers reported neurological symptoms compared to 11% of farmers and 5% of ceramic workers. | • Limited amount of participants for the study.                            |
| Solomon et al. (2007) | • Farmers who use sheep dip & pesticide handlers have more neurological symptoms. | • Limited amount of participants for the study.                            |
| Sunwook et al. (2016) | • Exposure affects somatosensory, vestibular systems, and central processing of sensory information for postural control. | • Level of exposure limited to self-reporting.  
• No control group. |

**Nursing Implications**

**Implication for Practice:**
- Farmers should be made aware of the health effects and outcomes of pesticide exposure.
- NPs and RNs should know about pesticide exposure risk.

**Implication for Education:**
- Farmers should learn about proper PPE use & handling of pesticides.

**Implication for Policy:**
- Require farmer training & certification in order to purchase pesticides.

**Implication for Research:**
- Further research needed with larger sample sizes.

**References**