



PARKINSON'S DISEASE & PESTICIDES

PREPARED BY: OFFICE OF MEDICAL AFFAIRS

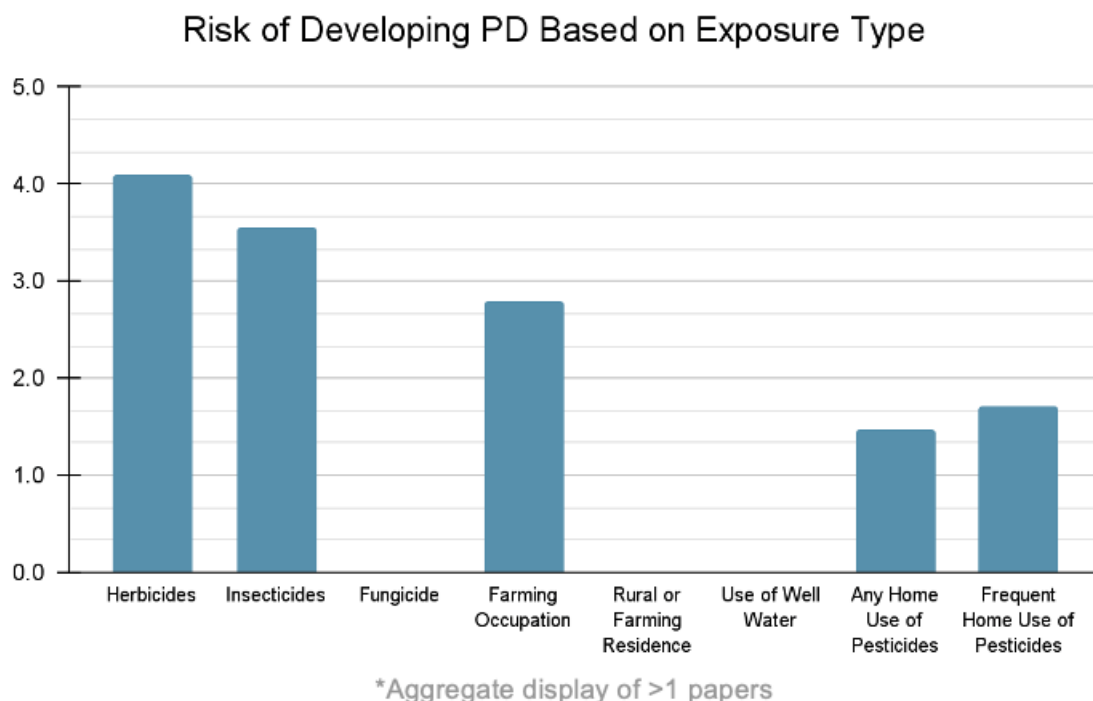
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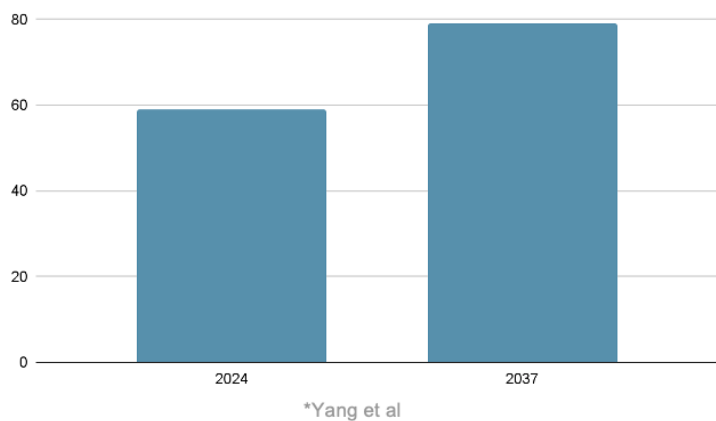


Key Takeaway Notes

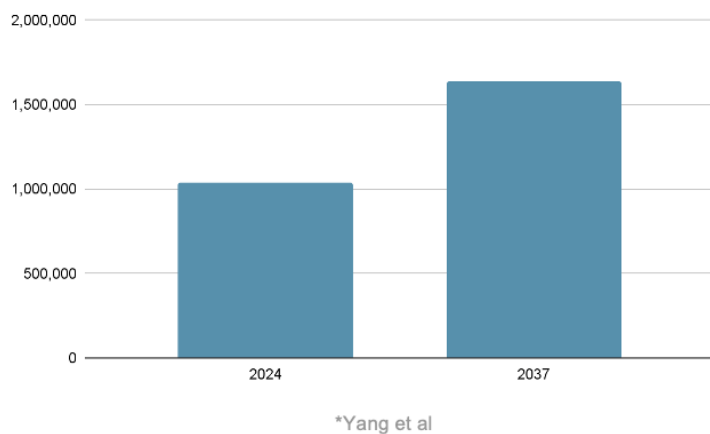
- Parkinson's Disease (PD) is a very serious condition. It limits people's mobility, autonomy, and their ability to process information.
- The correlation between exposure and risk for disease development is compelling.
- Experts recommend action that reduces exposures. Personal protective equipment, proper pesticide application, and reduced use would likely lower the risk for PD.
- Speak with your healthcare professional to learn more about preventing PD.
- Pest reduction is beneficial to many. The rise of PD prevalence and cost of PD care are reminders that important tradeoffs exist at the individual, community, and national levels.
- Do your commercial and industrial pesticide application practices concern you? Schedule a call with our management team here: <https://bit.ly/44Ec-1CZ>.



Forecasted Cost of Care for Parkinson's Disease



Parkinson's Disease Prevalence Forecasts



Background

Parkinson's Disease (PD) is a progressive neurodegenerative disease of the brain. It leads to problems with balance, movement and ultimately it leads to cognitive decline. The diagnosis of PD can have a long delay of up to 15 years before a patient is formally diagnosed. At a cellular level it is the death of dopamine producing cells in key areas of the brain that lead to these signs and symptoms. (Pardo - Moreno et al.) These authors cite about 5% of people with PD have a genetic variation that is the reason for the development of PD. The remainder are attributed to environmental factors which may include many issues. Pesticides, herbicides, insecticides, solvents, and fertilizers have shown significant associations with the subsequent development of PD. (Chen et al.) There is no cure for PD.

There are medications that are used to slow its progress. There are also devices such as deep brain stimulators which encourage the brain cells to release dopamine. Another invasive treatment uses stem cell implants placed into the affected area(s) of the brain as a way to slow the progress of the disease. Novel approaches are also cited in the literature. Examples include brain focused ultrasound (Univ of MD School of Medicine) and vaccines (Figuerido, PhD), gold nanocrystals (Maia, PhD), gene therapy (Parkinson's News Today), oral solutions, stem cells and various injections. Each effort attempts to re-establish a balance in the messenger molecules used to convert nerve cell messages into muscle movement and other important cognitive functions.

Existing Research:

A set of researchers in central California set out to establish whether a linkage existed between pesticide use and PD. This study covered occupational, residential, and household sources of pesticide exposure. The study showed an increased risk for the development of PD by 455%, if the subject ever used a carbamate. Their risk for PD doubled with organophosphates and organochlorines. Household pesticide use, ambient residential, and workplace exposures increased the risk between 46 to 68% respectively. (Shilpa et al.) Other research conducted in France with an older population attempted to determine if a relationship with pesticides and PD exists. Their research used a logistic regression analysis methodology on two cohorts and found statistical support for an association with PD and pesticide exposure. PD and professional use of pesticides were associated with an Odds Ratio (OR) of 1.8 with a dose related effect related to the number of years of use. Organochlorine insecticides were associated with a higher OR of 2.4 which

both demonstrate exposure was associated with twice the risk of developing PD.(Elbaz, MD, PhD et al.)

A Google search for Safety Data Sheet(SDS) / Material Safety Data Sheet(MSDS) examples available at several public facing websites found the pesticide Bifenthrin was associated with clinical signs of neurotoxicity described as tremors, impaired gait, and excessive salivation following acute or sub chronic exposure. The tremors disappeared with continued exposure in laboratory mice studies.(FMC Corporation) For a similar pesticide deltamethrin the SDS described neurotoxicity in lab studies with rats, mice and dogs manifest as unsteadiness, abnormal gait, tremors and excessive salivation along with additional symptoms. (Sunnyside Corp) These are signs and symptoms very consistent with PD or a PD-like disorder.

Household pesticides were also associated with an increased OR of developing PD over time. A population health case control study used California Dept. of Pesticide Regulation product label databases to identify ingredients of household pesticide products and used logistic regression to estimate the effect of these compounds on the risk of developing PD. Their research showed that any use resulted in an OR of 1.47; while frequent use carried an OR of 1.71 and frequent use of organ thiophosphate to nearly double the risk. In addition, they found a genetic variation 192QQ and frequent exposure were associated with the largest odds ratio. The authors conclude that household use of OP pesticides is associated with an increased risk of



developing PD. (Narayan et al.)

A family-based case-control study found that genetic variants (parkin, a-synuclein, DJ-1, PINK1 and LRRK2) exist for the development of PD. These are rare genetic risk factors for the development of PD in individuals. The authors state a meta-analysis suggests that people who have PD are twice as likely to report an exposure to pesticides. They conducted a survey to reconstruct the exposure patterns in the cohort based on recall. Activities such as farming and use of well water were not associated with a higher risk of developing Parkinson's disease. They found a pattern demonstrating a genetic predisposition that may be a trigger for PD after a pesticide exposure. In their research organochlorines and organophosphates are shown to significantly increase PD risk. Examples such as chlordane and DDT were biologically linked to PD by examination of brain tissue in these patients. These compounds were found in higher levels within the examined brains of the affected versus control patients. (Hancock et al.)

An article researched and published its findings to identify the factors

of pesticides, farming, well water and rural living. They used a population-based case control study consisting of patients at the Henry Ford Health System in metropolitan Detroit. There was a significant OR of 4.1 with herbicide exposure and 3.55 OR for insecticide exposure and no significant association with fungicide exposures. There was no increased Odd Ratio associated with rural or farm residence or well water use. (Gorewell, MD et al.)

Another analysis examined a population from within an American Cancer Society study that followed people for nearly a decade. A subsection (5.7%) of the cohort showed that farmers, ranchers or fishermen exposed to pesticides had a OR 1.7 or 70% higher likelihood of developing PD than those who were unexposed. (Ascherio et al.)

One publication we found did not find an increased risk of PD. Relative risk was assessed for various workplace factors, such as farming work, metal work, or exposure to pesticides, metals or solvents. The abstract did not describe the range or duration of exposures as a gradation of risk for the development of PD. (Firestone, MD, PhD, MPH et al.)



Cost of Care Considerations

It is important to understand the cost of care for PD patients. Widely cited research sponsored by Michael J. Fox Foundation for Parkinson's Disease, AbbVie Inc., ACADIA Pharmaceuticals, Acorda Therapeutics, Adamas Pharmaceuticals, and Biogen Inc., along with American Parkinson Disease Association and The Parkinson Alliance, published in 2020 examined data used to estimate the costs of PD care. This includes public and private administrative claims data, Medicare Current Beneficiary Survey, Medical Expenditure Panel Survey, and a primary survey (n=4,548) designed for this study. They estimate the prevalence of PD to be 1.04M patients and forecast an expected prevalence to increase to 1.64M people with PD by 2037. Their estimate is a total economic burden to be \$51.9B which is broken down in the adjacent table. The researchers forecast a model where the cost of care will rise to \$79.1B by 2037.

The data shows that 89% are Medicare eligible. That program would then bear the lionshare of the cost of care. Lower percentages are distributed into commercial, Medicaid, VA benefits, and out of pocket payment sources. They note that caregivers will spend an average of 22 hours per week supporting the patient. (Yang et al.) This would likely create an additional economic and productivity drag on the affected individual, the caregiver, and their surrounding communities.

Cost of Care for PD patients	
Direct Cost	\$25.4B
Indirect Cost	
- Reduced employment	\$2.7B
- Presenteeism	\$2.9B
- Disability Income	\$4.8B
- Premature Death	\$2.5B
- Absenteeism	\$5.1B
- Social Productivity	\$1.0B
Non-Medical Costs	\$7.5B

Summary Statement

Ample objective evidence exists to support new thinking around the risk of pesticide exposure and the risk of Parkinson's Disease. Efforts to reduce exposure risk are worthwhile pursuits and should be supported. Reductions in the prevalence and incidence of PD would improve the health of many people, reduce employer's costs and their employee's cost sharing. These approaches to reduce exposure risk would simultaneously reduce the cost of care borne by workman's compensation, commercial and state/federal healthcare insurance programs etc.



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