INFUENCE OF ENVIRONMENTAL FACTORS ON COMMON DEGENERATIVE DISEASES OF BRAIN

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ABSTRACT

Environmental factors like common dietary pattern, toxic chemical exposures, inadequate exercise and socio-economic stress are influencing common degenerative diseases. These influences can begin in the womb and continue throughout life, setting the stage for the later development of neurodegenerative as well as other chronic diseases. Nutritional, chemical, physical and social factors have a direct influence on the risk of Alzheimer's, Parkinson's and related chronic diseases. It is clear from these findings that our activities in the area of food and agriculture, energy, chemical use and social organisation are key drivers in the abnormal loss of neurological function in older people throughout the modern world.

Keywords: Neurodegenerative, dietary pattern, chronic diseases, neurologic

INTRODUCTION

Neurodegeneration is the progressive loss of structure of function of neurons including death of neurons. Many neurodegenerative diseases including Parkinson's, Alzheimer's diseases occur as a result of neurodegenerative processes. It may cause problems with movement or mental functioning. Environmental factors influencing degenerative diseases are -dietary patterns, toxic chemical exposure inadequate exercise, socio economic stress and other factors. These influences can begin in the womb and continue throughout life, setting the stage for the later development of neurodegenerative diseases.

Anthropogenic activities have been contributing to the spread of toxic chemicals in to the environment, including several toxic metals and metalloids, increasing the levels of human exposure to many of them. Contaminated food is an important route of human exposure and may

represent a serious threat to human health. Toxic metals specially Cd, Hg, Pb and As are affecting human health. The majority of the known metals and metalloids are very toxic to living organisms and even those considered as essential, can be toxic if present in excess. In the last decades, the natural environmental concentrations of several chemical, elements have been largely increased .mostly as a result of anthropogenic activities. They can impair important biochemical systems, constituting an important threat for the health. Some possible food sources of toxic chemical elements are shown in Table 1.

Influence of environmental factors on common degenerative diseases of the brain includes common dietary patterns, toxic chemical exposures, inadequate exercise, socio-economic stress and other factors. These influences can begin in the womb and continue throughout life, setting the stage for the later development

of neurodegenerative as well as other chronic diseases.

Environmental factors such as diet (fat-rich), heavy metals, biogenic metals and pesticides have been involved in AD developments due to their ability to disrupt metabolic pathways involved in the homeostasis of AD. In addition, factors such as lifestyle (antioxidants and exercise) can prevent AD developments.

Many of these environmental factors are oxidative agents acting through different mechanisms as discussed later. The brain is particularly vulnerable to oxidative stress due to its high glucose-based metabolic rate, low level antioxidants, high levels of polyunsaturated fatty acids, and high enzymatic activities related to transition metals that catalyze the formation of free radicals (Halliwell et al 1992).

Alzheimer's disease is the major form of dementia in elderly and possibly contributes to 60-70 % of cases. It is a progressive, disabling and irreversible disease (Goedert and spillantini, 2006).

There are two recognised forms of AD. The first one is named familial or of early onset (EOAD), which is directly related to specific gene mutations in the amyloid precursor protein(APP) and presenilin (PSEN) 1 and 2 genes, both related to the amyloid-beta (Aβ) peptide synthesis (Piaceri et al., 2013) . The EOAD begins at early age, less than 65 years, and only explains 5 % of all cases the second the late onset AD (LOAD) is the most common form of AD with 95% of all cases.

Parkinson's disease is a chronic and progressive neurological disorder characterized by the selective loss of dopaminergic neurons of the substantia nigra para compacta (SMpc). The cardinal features of the syndrome are related to motor dysfunction including tremor at rest, rigidity, akinesia (or bradykinesia), and postural instability. The motor symptoms appear when at least 60 % of dopaminergic neurons are lost and 80-85% of dopamine content in the striatum is depleted (Jankovic, 2008 : 2008 : Wirdefeldt et al., 2011).

There is no cure for PD, and the existing therapies only provide brief relief of motor symptoms through improving the dopamine deficit or by surgical methods. This highlights the need of research on early specific/differential biomarkers to have more accurate diagnosis of neurodegenerative disorders, as well as biomarkers for the identification of populations at risk to implement neuro protective therapies (Jankovic, 2008).

Environmental risk factors in the development of dementia, Alzheimer's disease and Parkinson's disease include:

➢ Lead- Recent evidence link environmental lead exposure in the community to increased risk of cognitive impairment. For example, a recent study of elderly men found that the highest lead exposed group had on average an additional 15 years of cognitive aging, compared to the lowest lead-exposures in infancy and child

may sharply increases the risk of Alzheimer's disease decades later. Evidence also implicates lead in increasing risk for Parkinson's disease as well. Cadmium is another toxic heavy metal associated with neurological alterations including memory loss and mental retardations (Wag and Du, 2013) . An early study observed higher plasma levels of various metals including Cd , aluminium (Al) , As, and Se in Ad patients compared with healthy volunteers (Basun et al., 1991)

➢ Pb was the most potent metal to induce Aβ , followed by Cd, and As had the smallest effect, however all did increase the APP production . Interestingly, they demonstrated a synergic effect of metals mainly due to As, the exposure to these three cations produced a dramatic increases in Aβ, PSENI, BACE1 and APP, suggesting an enhanced amyloidogenic processing (Ashok et al., 2015)

➢ Air Pollution – Recent studies air pollution is harmful to the brain, in addition to the lungs, heart, nose, and blood vessels. This evidence is drawn from studies of brains of the people living in highly polluted cities compared with those living in clean air cities. These studies found evidence starting at young ages of inflammation and cellular damage associated with both early Alzheimer's and Parkinson's diseases.

➢ Pesticides – A large body of data links exposure to a variety of pesticides with increased risk for Parkinson's disease. Evidence also links chronic low dose exposure to a number of pesticides- primarily in the work setting- with subsequent cognitive decline, such as impaired memory and attention; a study in France found that a history of occupational exposure to pesticides more than doubled the risk of developing Alzheimer's disease. Exposure to some pesticides has also been linked

to dramatically increased risk for diabetes, prediabetes, and metabolic syndromes.

➢ The association between chronic pesticide exposure and the prevalence of dementias, including AD has not been as well studies as with other environmental risk factors, and results are often in consistent. This is mainly because of the difficulties on getting adequate data on the levels of exposure of individual pesticides, which is often indirectly evaluated by structure questionnaires. Some of the studies with positive associations reveals that hazarad ratio for developing AD was slightly higher for organophosphate (OP) pesticides exposure than to the orgonochlorines (OCl) , after adjusting for some variables , including, ApoE genotype (Hayden et al., 2010)

➢ Dietary risk factors- Diet and nutrition are emerging as critical factors in brain health and health in general. A variety of nutrients increases the risk

of diseases. For example, several studies have shown that higher saturated fat intake increases the risk of dementia by two to three times. Animals studies also showed that young rats fed a high saturated fat diet had impaired learning and memory as adults compared to rats fed a diet high in polyunsaturated fat. Serious concern are also raised by a number of studies that infant soya formula or formulas fortified with the highest levels of iron may potentially increase the risk of subsequent Parkinson's disease.

➢ Dietary protective factors _ Diet and nutrition can also decreases risk of disease. For example, numerous studies in the people show that the high intake of omega -3 fatty acids is associated with markedly lower risk of Alzheimer's. In the Alzheimer's – prone laboratory animals, a high omega-3 diet begun in late life reduced marker of Alzheimer's disease in the brain by more than 70 %.

The Mediterranean diet, which includes fresh fruit and vegetables, legumes, whole grains, fish, nuts, and olive oil, is linked to substantially reduced the risk of both Alzheimer's disease and Parkinson's disease , as well as dramatically lower rates of diabetes, vascular disease, recurrent heart attacks , and metabolic syndrome.

➤ Physical Activity _ Exercise is linked to substantial reduction in the risk of dementia and Alzheimer's. One study found that subjects who were physically active at least twice a week in midlife had more than 50 percent reduction in the risk of dementia and Alzheimer's diseases in later life.

The toxic effect of metals and metalloids are partly due to the direct inhibition of enzymatic systems, and also to the indirect alteration of the essential metal-ion equilibrium. As a consequence their biological availability is inhibited and damage to the cell membrane can occur by the disruption of ion transport across it.

Other environmental agents examined in the report include bisphenol A, aluminium industrial emissions, solvent, PCBs, and electromagnetic fields. The role of physical stressors, education and socio economics status are also featured. The report author provide recommendations so that individuals, families, communities, and societies can take actions at all levels and move towards healthy living and healthy ageing. This is especially important because the population over the age of 65, which is highly vulnerable to chronic disease, is expected to nearly double. With that increase, will come a dramatic escalation of chronic disease unless steps are taken now to reduce the risk. Among these recommendations are:

➤ Increases sustainable, diversified and local alternatives to industrial farming – to improve the nutritional value of food, cut down on harmful content, ensure access to

healthy food, and lessen serious damage to the environment ;

➢ Regulatory reform of chemical policy that helps to prevent hazardous toxic exposures from air, water, food, and other consumer products ; business policy changes that give preference to purchasing and using products made of safer chemicals;

➢ Health care policy changes that increase the focus on disease prevention and ensure equitable and accessible health care for all.

An energy policy that reduces toxic emissions, promotes conservation and efficiency, curtails dependence on fossil fuels, and encourages more physical activity. In addition to these societal recommendations, the report contains recommendations for action for healthy living and healthy aging that individual can take to reduce the risks for Alzheimer's Parkinson's, and other diseases of the Western disease cluster. These include specific recommendations relating to;

➢ Eating healthy and nutritious food, and avoiding common hazards in the typical modern diet;

➢ Staying active physically and mentally;

➢ Avoiding harmful toxicants and pollutants; and,

Being socially engaged with family, friends and community the risk of neurodegenerative disease can be significantly impacted by individual life style choices, such as by eating nutritious food, staying active mentally and physically, and avoiding harmful pollutants.

Alzheimer's and Parkinson's disease risk are also heavily influenced by features of the family, community and society as a whole. Public health and policy approaches are essentials for disease preventions.

Conclusion

The emerging association between exposures to several toxic compounds with neurodegenerative disease is of considerable public health importance, given the increasing

dementia prevalence, the negative social economics consequences of neurodegenerative-related disabilities, and the increasing environmental pollutions in some geographic areas worldwide. Some of the epidemiological studies show not consistent result on getting significant estimates, of hazard risk for AD or PD, mainly due to some limitations that include the difficulty on accurate diagnosis for AD or PD cases due to the lack of specific biomarkers, the deficiency to accurately assess chronic exposures, and /or the lack of inclusion of important confounding variables such as co-exposure to toxic compounds, genetic variants and life style among other.

The oxidative stress induced by these neuro toxicants activates/ inhibits signalling pathway leading to augmented/diminished activity of enzymes that promote the accumulation of toxic materials in neural cells such as damaged/aberrant proteins, AB in AD or ɑ-syn in PD and oxidative by products, or the oxidation that can alter genetic or epigenetic

regulation . Furthermore, the link between early life exposure to environmental factors and the origin of neurodegenerative diseases getting attention and can help to clarify the role of the environment on the development of these degenerative diseases. On the other hand, the lack of specific / differential biomarkers for AD or PD limits the early diagnosis and then the timely treatment. In this regard, specific circulating mRNAs have been associated with pathological processes such as AD and PD , therefore they are promising non-invasive biomarkers for these neurologic .Additionally , the identification of biomarkers to determine the past exposure to environmental pollutants is of vital importance for better and opportune managements of these diseases. Thus , as we have more knowledge of the risk from the exposure to environmental pollutants , more well-designed epidemiological studies (controlling for as many variables as possible and with high sample sizes) are necessary to

improve the quality of life of elderly and to prevent the development of

neurodegenerative diseases worldwide.

Table 1: Some possible food sources of toxic chemical elements

Sr. No.	Pollutant	Possible food sources
1	Cadmium	Pea nut, soya bin, medicinal, herbs,lettuce,corn,oats,spinach,milk.eggs.cheese.fish,shrimp,oyster,mushroom,pig etc.
2	Lead	Carrots, lettuce, beetroots, moonshine, honey, smoked food ,wine ,beer, milk, mustered, wheat, mineral salt to beef cattle, eggs, cocoa powder, poultry, breast milk, tamarind candy, some folk remedies, buckwheat, raisin, calcium supplements, rice, potato, mussels.
3	Arsenic	Bovine and chicken meat, green papaya, rice, sheep, algae products, seafood, Indian mustered, tomato , flour, grape juice, cooked spinach, carrots, shrimp, wine, milk, soya sauce.
4	Mercury	Seafood, fish oil, eggs, human milk, mushrooms.

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