

Review Article

The Instrumental Enrichment Program [PEI] as a Pedagogical Proposal for the Risks of Exposure in Pesticide Applicators

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Abstract

Pesticide applicators are unaware of the risks to which they are exposed because they do not have specialized equipment to avoid exposure to them, the regulation of pesticides includes shortcomings from environmental legislation, since currently banned agrochemicals are used in Europe and the United States. United since 2007. Objective. Establish as a pedagogical proposal the Instrumental Enrichment Program for pesticide applicators from a qualitative perspective. Material and methods. A systematic review was made on the internet, based on articles indexed in Crossref using keywords such as poisoning, and Instrumental Enrichment Program. Results. The IEP has significant positive effects on reasoning skills in socially and culturally disadvantaged children through brain plasticity. In type II diabetes education in the community of Tenango de Doria, Hidalgo, the study demonstrated a decrease in serum glucose and glycosylated hemoglobin, after the intervention and in 62 primary school children, a 4.8% reduction in obesity. In summary, of a total of 29 references reviewed, 15% belong to postgraduate thesis, national and international official pages, they deal with the definition of pesticide poisoning and its standardization, 85% of references are to reference articles related to pesticide poisoning and the Instrumental Enrichment program. Conclusions Based on the revised references, the Instrumental Enrichment Program represents an innovative opportunity to work with pesticide applicators with the vision to evoke learning to reduce or avoid exposure to them.

Keywords: *pesticides; risks; pedagogy.*

Introduction

The massive use of pesticides occurred during the 1940s of the 20th century, after identifying the qualities for pest control offered by the organic compound Dichlorodiphenyltrichloroethane (DDT). Being a new tool and its adverse effects on health and the environment being unknown, multiple negligence occurred that ended in intoxications, contamination of the environment, manifested by the contamination of water, air, soil, contamination of the food chain, by highly degradable substances, that caused multiple diseases worldwide, in addition to the generation of biological resistance by agricultural pests [1] [2]. Nowadays, there are multiple organizations for the regulation of pesticide use, such as the World Health Organization (WHO) and the Food and Agriculture Organization of the United Nations (FAO). In Mexico, the agencies that have the greatest influence on the regulation of pesticides are the Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (SAGARPA), the Secretaría de Salud (SSA) and COFEPRIS, which authorizes the registration and issuance of free sale certificates for the export of pesticides and plant nutrients, as well as granting import permits for pesticides, plant nutrients and toxic or dangerous substances, after analysing, evaluating and assessing the corresponding technical, toxicological and safety information [3] [4] [5]. This monitoring activity is difficult because multiple activities are used as pesticides, however, in the catalogue issued by COFEPRIS, it has been agreed to classify pesticides by the criterion of persistence, from "slightly persistent" to "permanent" (more than 20 years), going through "highly persistent" (more than a year). The list of highly persistent or permanent compounds includes twelve compounds. It also classifies pesticides according to their level of toxicity, indicating five categories, from the slightly toxic (IV) to the extremely toxic [6] [7] [8]. Indeed, what is a pesticide? The Food and Agriculture Organization of the United Nations (FAO) understands pesticides as "any substance or mixture of substances intended to prevent, destroy or control any pest, including vectors of human diseases or animals, unwanted species of plants or animals that cause harm or that interfere in any way in the production, processing, storage, transport or marketing of food and agricultural product." [9]. For legal purposes we will understand pesticide according to the Federal Law of Plant Health as a "phytosanitary resource intended to prevent, repel, combat and destroy biological organisms harmful to plants, their products or by-products" and defines pest as "plant or animal life form or pathogenic agent, harmful or potentially harmful to plants [10]. The literature

points out the following groups of pesticides as being responsible for the majority of pesticide poisonings: organochloride, organophosphates, carbamates, pyrethrins, pyrethroids and anticoagulants [11]. Within the group of carbamates, we find Carbofuran or Furadan, a highly toxic chemical that is used in Metztitlán, Hidalgo, without adequate protection. Prohibited in Europe and the United States, this pesticide, like many others is operated in Mexico under the legend of "use under certain restrictions" [12].

Aim

Establish as a pedagogical proposal, the Instrumental Enrichment Program for pesticide applicators from a qualitative perspective. Organochloride pesticides are currently banned in much of the world due to their toxicity and bioaccumulation, with DDT, hexachlorobenzene, and pentachlorophenol as the main agents. 11 Given the aforementioned toxicity of the various chemicals handled as pesticides, it is not surprising that the work environments connected to agriculture have the highest incidence of cases due to pesticide poisoning; the annual cases of serious pesticide poisoning reach 3 million around the world; 25 million symptomatic poisonings by pesticides in the workplace occur each year among agricultural workers in developing countries [13]. In order to study such a complex situation, multiple variables must be taken into account, such as the diversity of commercialized products, the rate of use, the multiplicity and simultaneity of sources of exposure, and the variation in intensity and duration of exposure over time, among others. Usually, the symptoms of acute poisonings reported by pesticide applicators are of dermatological and cardiorespiratory type. According to the literature, we can find a frequency range of 20 to 50% of pesticide applicators with irritative symptoms, fatigue, headache and depression-related anxiety [11] [12] [14]. The symptoms of organophosphate toxicity are manifested as a result of the inhibition of the enzyme acetylcholinesterase, found mainly in the conduction tissues such as muscles and nerves, as well as sensory and motor fibers. The activity of cholinesterase is measurable in erythrocytes and plasma. In Australian pesticide applicators, significant statistical decreases in the activity of acetylcholinesterase have been observed with respect to a reference value and control group, in 3 different measurements [15]. As has been reviewed, the chemicals used as pesticides to control pests in agricultural products are part of the base on which we sustain agricultural activities and to which society owes much of its progress; however, they are highly toxic to human health and the environment. Cases of acute pesticide poisoning are a major cause of morbid-

ity and mortality worldwide and the developing countries are particularly vulnerable. Despite the efforts of different agencies in Mexico, the regulation of these products is considered low compared with the regulation in highly developed countries. Alongside this problem is a low compliance with the rules and insufficient access to information systems [3] [14]. In an ethno-phenomenological study, conducted in Metztitlán Hidalgo, it was found that the interviewed agricultural workers signal the acute toxic impact that pesticides have on their health, however, they do not know the long term risks involved in the application of these chemicals, such as damage to the nervous system, reproductive diseases, damage to the endocrine system and even cancer or tumors. The limited knowledge they have about security measures, the inaccessibility to the necessary security measures to avoid exposure and the need to work are influenced by their socio-economic status and their health education [16] [17]. Hence, it is necessary to implement socio-cultural, epidemiological and health education strategies to transform the uses and customs of farmers so that they use the complete safety equipment and properly dispose of empty containers of agrochemicals, which will prevent damage to personal and family health, as well as reduce the environmental impact. In a study conducted in the region of Moja, Colombia, it was determined that there is a statistical relationship between health implications due to the use of pesticides and the levels of study and training received; 55.5% of pesticide applicators had only primary education, 96.5% perform hand washing after the application of pesticides, 49.5% eat at their workplace and 83% do not use protective elements when performing their work [18] [19] [20]. Similarities were found in the research carried out in Mixquiahuala de Juárez, Hidalgo, where they indicate that "a culture underlies the value given to the use of protection during the application of pesticides, since they consider that the suits are uncomfortable; they believe that not all products require protection, for example products that have a green label and contain a 'slightly toxic' legend, are believed to be nontoxic, and therefore they do not use protective measures with them" [17] [20] [21]. In a research in Córdoba, Colombia, interviews were conducted with 486 fumigators. The findings showed that "89.8% lack valid knowledge about risks produced by the chemicals and do not use protection measures. 89% transport agrochemicals together with other food supplies, 87%, discard the containers at the edges of plantations; 14.4% routinely perform safe handling practices; 13.1% indicated that they reuse pesticide containers to transport liquids for consumption" [19]. The program developed by Reuven

Feuerstein is known as the Instrumental Enrichment Program (IEP), which raises the possibility of modifying the cognitive structures of humans through brain auto plasticity [22]. The program seeks not only partial changes in the improvement of cognitive and behavioural skills of individuals, but rather a permanent change in the life structure of these. With regard to public health issues, this program has been used specifically in education in type II diabetes in the community of Tenango de Doria, Hidalgo. Quantitatively, the study demonstrated the decrease in serum glucose and glycosylated hemoglobin, after the intervention.²⁶ In addition to this project, in another study the IEP was applied in 62 primary school children who showed a 4.8% reduction in obesity after 4 weeks of intervention [27]. During an intervention of 15 case studies of children with intellectual disabilities, the IEP has significant positive effects on reasoning skills, but its benefits have also been corroborated in socially and culturally disadvantaged children [28] [29] [30].

Methodology

Study Design and Literature Collection

The present review was conducted using a comprehensive and systematic evaluation of published scientific literature related to metagenomic analysis of soil microbial communities under regenerative and conventional agricultural systems. Relevant peer-reviewed articles were retrieved from electronic databases including PubMed, Scopus, Web of Science, and Google Scholar using keywords such as "soil metagenomics," "regenerative agriculture microbiome," "conventional farming soil microbes," "16S rRNA sequencing," "shotgun metagenomics," and "soil microbial diversity" (17, 18). Studies published between 2005 and 2025 were preferentially included to capture recent advancements in next-generation sequencing technologies and microbial ecology. Inclusion criteria comprised studies investigating soil microbial diversity, functional gene profiling, microbial abundance, antimicrobial resistance genes, and ecological functions under regenerative and conventional agricultural practices. Studies based solely on culture-dependent techniques were excluded because of their inability to represent the total soil microbial diversity (19, 20).

Material and methods.

A systematic review was made in the internet, based on articles indexing in Crossref using keywords such as pesticides, poisoning, Instrumental Enrichment Program.

Results

The program developed by Reuven Feuerstein is known as the Instrumental Enrichment Program (IEP), which raises the possibility of modifying the cognitive structures of humans through brain auto plasticity [22]. The program seeks not only partial changes in the improvement of cognitive and behavioural skills of individuals, but rather a permanent change in the life structure of these. With regard to public health issues, this program has been used specifically in education in type II diabetes in the community of Tenango de Doria, Hidalgo. Quantitatively, the study demonstrated the decrease in serum glucose and glycosylated hemoglobin, after the intervention [26]. In addition to this project, in another study the IEP was applied in 62 primary school children who showed a 4.8% reduction in obesity after 4 weeks of intervention [27]. During an intervention of 15 case studies of children with intellectual disabilities, the IEP has significant positive effects on reasoning skills, but its benefits have also been corroborated in socially and culturally disadvantaged children [28] [29] [30]. The summary of a total of 29 references reviewed 15% belongs to a graduate thesis, national and international official pages, verse on the definition of pesticide poisoning and its standardization, 85% of references to reference articles related to poisoning pesticides and the Instrumental Enrichment Program.

Discussion

As has been demonstrated in previous studies, an intervention is urgently needed to prevent poisoning by pesticides with different approaches to control this public health problem. Within the literature, we can find in Mexico and other parts of the world the development and research of biofertilizers, for example, based on plant-growth-promoting rhizobacteria which offer an attractive way to replace chemical fertilizers, pesticides and supplements [20], even biodegrade pesticides through the action of these microorganisms [21]. However, in most of the literature, it is proposed to address the problem from a health education approach. Trying to rehabilitate deteriorated cognitive functions in children and adolescents, Reuven Feuerstein developed a theory of cognitive structures which was successfully used after World War II [22] [23]. This acquires relevance given that there is evidence that chronic occupational exposure to organophosphorus pesticides (OP) is systematically associated with deficits in neurological behavior tests [23]. Through biomarker analysis, it is suggested that oxidative stress, and not cholinesterase inhibition, in exposure to organophosphates such as CPF contributes to cognitive deficits; sub chronic exposures to CPF affect learning and mem-

ory through effects in the amygdala and the hippocampus [24].

Conclusion

Apparently, the Instrumental Enrichment Program has not been implemented to cause transcendental learning in pesticide applicators, especially to avoid exposure to toxic-poisonous, genotoxic and carcinogenic substances such as the aforementioned pesticides. Based on the revised references, the IEP represents an innovative opportunity to work with pesticide applicators with the vision of promoting learning to reduce or avoid exposure to these substances.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Artificial Intelligence

The authors declare that no artificial intelligence was used in any of the sections.

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