

Pesticide Residues in Children's Diets: A Comprehensive Review of Health Risks, Agroecology, and Policy Implications

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Abstract

The presence of pesticide residues in children's diets is a significant public health concern. This comprehensive review examines the prevalence of pesticide residues in children's diets, the potential health risks associated with exposure to these chemicals, and the role of agroecology in promoting healthier food options. I've conducted a literature review, comparative analysis, policy analysis, and case studies to gain a deeper understanding of this issue and identify potential policy changes and interventions needed to address it. My findings indicate that promoting agroecology and organic food production can reduce the reliance on chemical pesticides and provide healthier food options for children. Furthermore, implementing and expanding farm-to-school programs and prioritizing organic food in school feeding programs can help reduce children's exposure to pesticide residues. By raising public awareness and investing in research on the health impacts of pesticide residues, we can work towards creating a safer and healthier food system for future generations.

1 Introduction

Pesticide residues in children's diets have become a growing concern due to their potential health risks and the increasing prevalence of these chemicals in various food items. Children are particularly vulnerable to the harmful effects of

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pesticide exposure, as their developing bodies are more susceptible to the toxic effects of these chemicals. This comprehensive review aims to explore the issue of pesticide residues in children's diets, the potential health risks associated with exposure to these chemicals, and the role of agroecology in promoting healthier food options. We will conduct a literature review, comparative analysis, policy analysis, and case studies to gain a deeper understanding of this issue and identify potential policy changes and interventions needed to address it.

The literature review will cover studies investigating the presence of pesticide residues in food items commonly consumed by children, as well as research examining the potential health risks associated with exposure to these chemicals. We will also review literature on agroecology, organic food production, and their potential role in reducing pesticide residues in children's diets.

The comparative analysis will involve comparing the findings of the summarized scientific article with other similar studies conducted in different regions or countries. This will help us identify trends, patterns, and differences in the prevalence of pesticide residues in children's diets and the associated health risks.

The policy analysis will focus on examining pesticide use, food safety, and agroecology policies in Brazil and other countries. We will analyze the effectiveness of these policies in addressing the issue of pesticide residues in children's diets and explore potential policy changes and interventions that could help reduce the prevalence of these chemicals in food items.

Finally, I will present case studies that highlight successful initiatives and best practices in reducing pesticide residues in children's diets and promoting healthier food options. These case studies will serve as examples for policymakers and stakeholders to consider when developing strategies to address this critical issue.

2 Literature Review

2.1 Pesticide Residues in Children's Diets

Several studies have investigated the presence of pesticide residues in various food items commonly consumed by children, such as fruits, vegetables, cereals, and dairy products. These studies have analyzed the prevalence of pesticide residues in children's diets and identified trends or patterns in the data.

Bocquené and Franco (2005) [2] conducted a review of the occurrence of pesticide residues in food items and their potential impact on human health. They found that pesticide residues were frequently detected in fruits and vegetables, with some samples exceeding the established maximum residue limits (MRLs). The study also highlighted the need for improved monitoring and enforcement of MRLs to protect consumers, particularly children, from the potential health risks associated with pesticide exposure.

Lu et al. (2006) [3] examined the dietary exposure of children to organophosphorus (OP) pesticides, which are commonly used in agriculture. The study

found that children consuming conventionally grown fruits and vegetables had significantly higher levels of OP pesticide metabolites in their urine compared to those consuming organic produce. This suggests that consuming organic food items may help reduce children's exposure to pesticide residues.

2.2 Health Risks Associated with Pesticide Residues

Research has also examined the potential health risks associated with exposure to pesticide residues, particularly for vulnerable populations like children. These studies have focused on the toxicological impacts of these chemicals, as well as any potential synergistic or potentiating effects when multiple residues are present.

Curl et al. (2003) [4] investigated the potential health risks associated with dietary exposure to pesticide residues in children. The study found that children consuming conventionally grown fruits and vegetables had higher levels of pesticide metabolites in their urine compared to those consuming organic produce. The authors concluded that consuming organic food items may help reduce children's exposure to pesticide residues and their associated health risks.

Mostafalou and Abdollahi (2013) [5] conducted a review of the toxicological effects of pesticides on human health, with a focus on vulnerable populations such as children. The study highlighted the potential neurotoxic, endocrine-disrupting, and carcinogenic effects of pesticide exposure, as well as the potential for synergistic effects when multiple residues are present. The authors emphasized the need for improved monitoring and regulation of pesticide use to protect children's health.

2.3 Agroecology and Healthier Food Options

Literature on agroecology, organic food production, and their potential role in reducing pesticide residues in children's diets has also been reviewed. These studies have explored the benefits of these practices for human health and the environment, as well as any challenges or barriers to their widespread adoption.

Gomiero et al. (2011) [6] conducted a review of the environmental and health impacts of organic and conventional agriculture. The study found that organic farming practices generally result in lower pesticide residues in food items, reduced environmental contamination, and improved soil health. However, the authors also noted that organic farming may face challenges related to lower crop yields and higher production costs compared to conventional agriculture.

Mie et al. (2017) [7] reviewed the potential health benefits of organic food consumption, focusing on the reduction of pesticide residues in the diet. The study found that organic food items generally have lower levels of pesticide residues compared to conventionally grown products, which may help reduce the risk of adverse health effects associated with pesticide exposure. The authors also highlighted the need for further research to better understand the potential health benefits of organic food consumption and to address the challenges and barriers to the widespread adoption of organic farming practices.

3 Comparative Analysis

To perform a comparative analysis of the summarized scientific article with other similar studies conducted in different regions or countries, I will focus on the following aspects:

1. Prevalence of pesticide residues in children's diets
2. Types of pesticide residues detected
3. Health risks associated with pesticide residues

3.1 Prevalence of Pesticide Residues in Children's Diets

Chavarri et al. (2004) [8] investigated the presence of pesticide residues in fruits and vegetables consumed by children in Spain. The study found that 47

Oates et al. (2014) [9] conducted a study in Australia to assess the dietary exposure of children to pesticide residues. The study found that pesticide residues were detected in 69

3.2 Types of Pesticide Residues Detected

Krol et al. (2000) [10] analyzed the presence of organochlorine pesticide residues in food items consumed by children in Poland. The study found that the most frequently detected pesticide residues were DDT and its metabolites, followed by hexachlorobenzene and lindane. These findings indicate that different regions may have varying patterns of pesticide use and residue detection, which could influence the types of pesticide residues found in children's diets.

Sharma et al. (2014) [11] investigated the presence of pesticide residues in fruits and vegetables consumed by children in India. The study found that the most commonly detected pesticide residues were organophosphorus compounds, followed by synthetic pyrethroids and carbamates. This highlights the need for region-specific monitoring and regulation of pesticide use to address the unique patterns of pesticide residues detected in children's diets.

3.3 Health Risks Associated with Pesticide Residues

Bouchard et al. (2011) [12] conducted a study in the United States to assess the impact of pesticide exposure on children's cognitive development. The study found that higher prenatal exposure to organophosphate pesticides was associated with lower cognitive scores in children, suggesting potential long-term health risks associated with pesticide residues in the diet.

Rauh et al. (2011) [13] investigated the association between prenatal exposure to chlorpyrifos, an organophosphate pesticide, and neurodevelopmental outcomes in children in New York City. The study found that higher prenatal exposure to chlorpyrifos was associated with lower cognitive scores and increased risk of attention problems and developmental disorders in children.

These comparative studies highlight the varying prevalence and types of pesticide residues detected in children’s diets across different regions and countries. They also emphasize the potential health risks associated with exposure to these residues, particularly during critical periods of development. This underscores the importance of effective monitoring, regulation, and enforcement of pesticide use to protect children’s health and well-being.

4 Policy Analysis

To perform a policy analysis related to pesticide use, food safety, and agroecology in Brazil and other countries, I will focus on the following aspects:

1. Pesticide regulation and monitoring
2. Food safety standards and enforcement
3. Promotion of agroecology and organic production
4. School feeding programs and food procurement policies

4.1 Pesticide Regulation and Monitoring

In the European Union, Regulation (EC) No 1107/2009 [14] governs the approval and use of plant protection products, including pesticides. The regulation sets strict criteria for the approval of active substances and requires member states to monitor pesticide residues in food products. This policy has contributed to a more harmonized approach to pesticide regulation and monitoring across EU member states, ensuring a higher level of consumer protection.

In the United States, the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) [15] regulates the registration, sale, and use of pesticides. The Food Quality Protection Act (FQPA) [15] establishes safety standards for pesticide residues in food, taking into account the specific vulnerabilities of children. These policies have led to a more comprehensive regulatory framework for pesticide use and monitoring in the United States, helping to reduce the potential health risks associated with pesticide residues in children’s diets.

4.2 Food Safety Standards and Enforcement

The European Union’s Regulation (EC) No 396/2005 [16] establishes maximum residue limits (MRLs) for pesticide residues in food and feed products. The regulation requires member states to monitor pesticide residues in food products and enforce compliance with MRLs. This policy has contributed to a more consistent approach to food safety standards and enforcement across the European Union, ensuring that food products meet stringent safety requirements.

In the United States, the Environmental Protection Agency (EPA) sets tolerances for pesticide residues in food under the Federal Food, Drug, and Cosmetic

Act (FFDCA) [17]. The EPA works closely with the Food and Drug Administration (FDA) and the United States Department of Agriculture (USDA) to monitor and enforce compliance with these tolerances. This collaborative approach has helped to ensure that food products in the United States meet strict safety standards, reducing the potential health risks associated with pesticide residues.

4.3 Promotion of Agroecology and Organic Production

In the European Union, the Common Agricultural Policy (CAP) includes measures to support agroecology and organic farming, such as agri-environmental schemes and organic farming payments [?]. These policies have contributed to the growth of organic agriculture in the European Union, providing consumers with healthier food options and reducing the reliance on synthetic pesticides.

In the United States, the USDA's National Organic Program (NOP) regulates and promotes organic agriculture, setting standards for organic production and certification [?]. The USDA also supports agroecology research and education through programs such as the Sustainable Agriculture Research and Education (SARE) program [?]. These policies have helped to promote the adoption of agroecological practices and organic production in the United States, providing consumers with healthier food options and reducing the potential health risks associated with pesticide residues.

4.4 School Feeding Programs and Food Procurement Policies

In the European Union, the Farm to School program encourages schools to source food from local farmers and promote healthy eating habits among students [?]. This policy has helped to increase the availability of fresh, locally produced food items in schools, reducing children's exposure to pesticide residues and promoting healthier diets.

In the United States, the Farm to School program, administered by the USDA, supports schools in procuring local and sustainably produced food items, including organic products [?]. This policy has contributed to the growth of farm-to-school initiatives across the country, providing children with healthier food options and reducing their exposure to pesticide residues.

These policy analyses highlight the importance of effective regulation, monitoring, and enforcement of pesticide use, as well as the promotion of agroecology and organic production, in reducing the potential health risks associated with pesticide residues in children's diets. They also emphasize the role of school feeding programs and food procurement policies in promoting healthier food options for children and reducing their exposure to pesticide residues.

5 Case Studies

To identify and analyze successful examples of agroecological practices, organic food production, and school feeding programs that prioritize healthy, pesticide-free food options for children, we will focus on the following case studies:

1. Organic School Meals in Denmark [18]
2. Agroecological Practices in Cuba [19]
3. Farm to School Program in the United States [20]

5.1 Organic School Meals in Denmark

He et al. (2014) [18] examined the impact of implementing organic school meal programs in Denmark. The study found that schools that adopted organic food procurement policies experienced a significant increase in the consumption of organic food items by students. Additionally, the study reported that the organic school meal program led to a reduction in the overall environmental impact of food production, as well as an increase in the consumption of fruits and vegetables by students. This case study demonstrates the potential benefits of prioritizing organic food in school feeding programs, both in terms of reducing children's exposure to pesticide residues and promoting healthier eating habits.

5.2 Agroecological Practices in Cuba

Rosset et al. (2011) [19] analyzed the widespread adoption of agroecological practices in Cuba following the collapse of the Soviet Union and the subsequent loss of access to synthetic pesticides and fertilizers. The study found that the shift towards agroecology led to increased crop yields, improved soil health, and reduced reliance on chemical inputs. Furthermore, the adoption of agroecological practices contributed to greater food security and self-sufficiency in the country. This case study highlights the potential benefits of agroecology in reducing the presence of pesticide residues in food items and promoting more sustainable and resilient food systems.

5.3 Farm to School Program in the United States

Joshi et al. (2008) [20] evaluated the impact of the Farm to School program in the United States, which aims to connect schools with local farmers and promote the consumption of fresh, locally produced food items. The study found that the program led to increased consumption of fruits and vegetables by students, as well as greater awareness and appreciation of healthy eating habits and local food systems. Additionally, the program provided economic benefits to local farmers and communities. This case study demonstrates the potential of farm-to-school programs in promoting healthier food options for children, reducing their exposure to pesticide residues, and supporting local agriculture.

6 Recommendations

Based on the findings, I provide the following set of recommendations for reducing the presence of pesticide residues in children's diets and promoting healthier food options through agroecology and organic food production:

1. Strengthen pesticide regulation and monitoring: Improve the effectiveness of pesticide regulation and monitoring systems to ensure that food products meet stringent safety standards and minimize the risk of pesticide residues in children's diets.
2. Enhance food safety standards and enforcement: Strengthen food safety standards and enforcement mechanisms to ensure compliance with maximum residue limits and protect children from potential health risks associated with pesticide exposure.
3. Promote agroecology and organic food production: Support the adoption of agroecological practices and organic food production systems to reduce the reliance on synthetic pesticides and minimize the presence of pesticide residues in food items.
4. Support research on the health impacts of pesticide residues: Encourage and fund research to better understand the potential health risks associated with exposure to pesticide residues, particularly for vulnerable populations like children.
5. Implement and expand farm-to-school programs: Establish and expand farm-to-school programs that connect schools with local farmers and promote the consumption of fresh, locally produced, and organic food items.
6. Prioritize organic food in school feeding programs: Encourage schools to prioritize organic food in their feeding programs to reduce children's exposure to pesticide residues and promote healthier eating habits.
7. Raise public awareness and education: Increase public awareness and education on the potential health risks associated with pesticide residues in children's diets and the benefits of agroecology and organic food production.

7 Conclusion

In conclusion, the presence of pesticide residues in children's diets is a significant public health concern, as demonstrated by the Rio de Janeiro study and other similar research conducted in different regions and countries. The majority of analyzed food samples contained multiple pesticide residues, indicating potential misuse and/or indiscriminate use of these products. The high index of samples with multiple pesticide residues highlights the potential health risks associated with the consumption of such foods, especially for children under 5 years old.

My comparative analysis, policy analysis, and case studies have provided valuable insights into the global scope of this issue and the potential policy changes and interventions needed to address it. By promoting agroecology and organic food production, humans can reduce the reliance on chemical pesticides and provide healthier food options for children. Furthermore, implementing and expanding farm-to-school programs and prioritizing organic food in school feeding programs can help reduce children's exposure to pesticide residues.

It is essential to assess the toxicological impacts of pesticide use on children's health, expand the acquisition of organic foods by school feeding programs, and strengthen agroecology with incentives and public policies for the protection and promotion of collective health. By raising public awareness and investing in research on the health impacts of pesticide residues, humanity can work towards creating a safer and healthier food system for future generations.

In summary, addressing the issue of pesticide residues in children's diets requires a multifaceted approach that includes effective regulation and monitoring of pesticide use, enforcement of food safety standards, promotion of agroecology and organic production, and implementation of school feeding programs and food procurement policies that prioritize healthy and sustainable food options. By learning from the experiences of Brazil, the European Union, and the United States, policymakers can develop and implement strategies to reduce the prevalence of pesticide residues in children's diets and protect their health and well-being.

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