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Food Waste: A Global Problem and Strategies to Reduce it

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Abstract

Food is essential for survival and nourishment. However, food poverty and insecurity have increased globally, especially during and after the COVID-19 pandemic. Meanwhile, environmental degradation has led to decreased crop yields, widening the gap between food production and demand. Despite this, food waste remains a critical issue, with global losses estimated at 30–50%. Reducing food waste is a key step in addressing food insecurity. Education, particularly among children, plays a crucial role in waste reduction. This review explores the role of paediatricians in raising awareness and engaging parents, caregivers, and educators in food waste prevention strategies.

Keywords: Food waste, food loss, food waste reduction, climate change

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INTRODUCTION

Food waste refers to the disposal of edible food that could have met nutritional needs (1). The Barilla Center for Food and Nutrition (BFCN) defines food waste as the loss occurring during harvesting, processing, distribution, or consumption (2). Food production requires money, resources, time, and effort. And food waste also means the waste of these valuable resources. Food poverty and food insecurity are a genuine new world problem, and food waste amplifies this issue. Greenhouse gas emissions from food waste contribute to climate change, exacerbating global warming. Thus, food waste is an economic, social, public health, and environmental problem, and efforts to lessen it should be strengthened (3). In the developed world, most food waste is at the consumer level (4), with children contributing significantly to it (5). As the future adult consumers, children's knowledge, attitudes, and behaviors regarding food must be shaped to reduce waste. This review is an attempt to point out the strategies at the parent, teacher, society, and child level to minimize this waste for the welfare of society and the environment. Pediatricians interact with many of these individuals and therefore have a significant responsibility in helping to reduce food waste.

THE MAGNITUDE OF GLOBAL FOOD WASTE AND ITS EFFECTS

In 2015, the United Nations set up Sustainable Development Goals, aimed at being achieved by 2030. They emphasized that food production needs to be sustainable, and that food loss should be minimized at all costs. To achieve this, the UN outlined in Sustainable Development Goal 12.3 that the current per capita global food waste must be halved by 2030 (6). Global food statistics indicate that nearly one-third of the world's food production is wasted (7). This waste occurs along the food supply chain, from the fields to the dining tables. In the developed world, 40% of food wasted is at the retailer and consumer levels, whereas in the developing world, most waste happens at the production and processing stages (8). Food loss amounts to 1.3 billion tons in weight per year (9). In Europe and North America, the waste is as high as 95 to 115 kg per person annually. In China, it is 6% of the food produced. The total value of global food waste is estimated at USD 1 trillion (8). An Italian study revealed that food waste in the region studied rose from 187.2 g per person per week to 203.8 g over three years from 2018 to 2021 (10). Food waste also results in the waste of water used for irrigation and food production, amounting to approximately one-quarter of the world’s water supply, or 200 liters per person per day. This equates to the loss of 21% of the world's freshwater, 19% of fertilizer, and 18% of cropland. Additionally, wasted food accounts for 21% of landfill volume and contributes to 4.4 gigatons of carbon emissions annually, representing 10% of global carbon emissions (9). Surveys have shown that of the total food wasted, fruits, vegetables, and root crops account for 40–

50%, fish for 35%, cereals for 30%, and oilseeds, meat, and dairy for 20% (8). An Italian survey found that food waste was higher among urban dwellers, with the most commonly wasted items being fruits, vegetables, milk, yogurt, bread, and non-alcoholic drinks. The same study also identified seasonal variations in food waste, with fruits being discarded most frequently in July, while rice, potato products, pasta, legumes, and soups were wasted more in November (10). The food wasted globally could feed four times the number of people currently suffering from hunger. While 800 million people lack adequate food, the amount wasted is sufficient to feed 3 billion individuals (8).

As the global population continues to grow, food production will need to increase by 70% compared to current levels to meet future demands (8). However, food production is declining despite genetic advancements aimed at increasing crop yield and resilience. This decline is driven by multiple factors, including deforestation, soil erosion, fertilizer overuse, pollution, and global warming, all of which negatively impact crop growth (11). Given these challenges, it is crucial to conserve and use available food resources efficiently. Reducing food waste is vital not only for food security but also for mitigating greenhouse gas emissions and their adverse effects on climate change, crop production, and overall agricultural sustainability.

FACTORS PROMOTING FOOD WASTE

To reduce food loss, one must first understand the causes and factors that promote food waste. Food waste occurs at various stages along the food chain, and multiple factors contribute to it, varying by region, family habits, and eating practices.

At production and retailer levels

At the production stage, food waste occurs because consumers often reject deformed or misshapen fruits and vegetables. As a result, farmers discard these imperfect products, knowing they will not sell in the market (12). This constitutes food waste at the post-harvest level. Additionally, improper storage at markets and retailer levels leads to further food loss (1).

At household levels

Many households purchase excess food due to overbuying and poor meal planning. Surveys have linked increased food waste to supermarket shopping, where promotions encourage bulk purchases, often leading to surplus food that eventually gets discarded (13). The quantity purchased often exceeds what a family can realistically consume. Food waste tends to be lower when people buy groceries from different sources or grow their own food in kitchen gardens. Some cultures also have a tendency to prepare excessive amounts of food, leading to leftovers that are often thrown away, further contributing to waste (14). Food waste also occurs during meal preparation when edible parts

of fresh produce are discarded. Many people are unaware that vegetable scraps they throw away could be transformed into delicious dishes with minimal effort. Excessive peeling can also lead to the unnecessary loss of edible food. Additionally, poor pantry management results in food spoilage when stored items are not used within their shelf life (13).

The influence of social media trends, such as 'mukbang' (eating shows where individuals consume large amounts of food in front of an audience), has also contributed to food waste, as followers mimic binge-eating behavior (8). In some households, leftovers are discarded for status reasons. Similarly, in restaurants, many diners order more than they can consume and do not take the leftovers home. As a result, large amounts of food end up in waste bins rather than being repurposed or even consumed by stray animals such as dogs, cats, or cows. Lack of awareness about food waste and its consequences also contributes to the problem, as many people do not take steps to reduce it (15). Governments and various organizations conduct awareness campaigns to educate people about food loss and ways to minimize it. However, despite attending such programs, many individuals fail to apply these practices in their daily lives.

At commercial eateries

In many restaurants, portion sizes exceed what an individual can eat, leading to food waste. Additionally, if restaurants prepare more food than they sell, the excess is discarded. While some food waste is unavoidable, proper food management strategies can help reduce it (16).

Use-by and best-before dates

A survey by Respect Food found that 63% of people do not understand the difference between 'Use by' and 'Best before' dates on food labels (17). 'Use by' dates indicate the last safe day to consume the product before it becomes unsafe or perishes. In contrast, 'Best before' dates suggest that the food is still safe to eat after the indicated date, though its quality may decline. This lack of awareness among consumers contributes significantly to food waste (18). Due to substantial food waste, farmers earn lower profits, and commodity prices increase. Organic waste is particularly harmful, as it generates methane, a greenhouse gas 80 times more potent than carbon dioxide in terms of warming effects (8).

CHILDREN AS FOOD WASTERS

At home

Children are significant contributors to food waste (19). Surveys indicate that households with young children waste more food than those without (20). This is largely because children are unaware of how food waste contributes to global issues. They tend to be picky eaters, prioritizing taste over nutrition and often mimicking their peers' eating habits. Parents, on the one hand, purchase nutritious foods for their children, but on the other hand, children often prefer less nutritious options. This conflict frequently leads

to food waste. Additionally, young children tend to be more focused on play, digital entertainment, or studies rather than eating, causing them to consume less and waste more (21). Some parents recognize the problem of food waste and wish to avoid it for economic reasons, yet they struggle to get their children to eat healthily while also minimizing waste (22).

A Canadian study examining families with children found a connection between diet quality and food waste. The researchers discovered that 81% of the families had diets that needed improvement, with highly nutritious foods such as fruits and vegetables being wasted the most (23).

At school

Schools and daycare centers that provide meals to children also generate significant food waste. A Portuguese study conducted in child daycare centers in Maceió, Alagoas, found that children wasted more than 10% of 68% of the food items served. Foods high in dietary fiber, vitamin A and C, calcium, iron, and zinc were wasted more frequently, highlighting the risk of nutritional deficiencies despite the availability of healthy meals (24). A 2017 study by Niaki SF et al. found that younger elementary school children wasted more food than older students. The authors suggested that targeted interventions for younger children could help reduce food waste (25). This age group often experiences neophobia (a fear of trying new foods) and prefers sweet, oily, or salty foods. Additionally, young children may struggle to communicate their hunger and satiety, leading to oversized portions and subsequent waste (20).

A study in peri-urban Vietnam found that 23% of the food served in schools was wasted, with vegetables being the most commonly discarded item. The research also revealed that girls wasted more food than boys and that larger portions led to increased waste (26). Similarly, a French school meal survey reported that cooked vegetable waste ranged from 66–83%, with starchy foods, dairy products, fruits, and desserts also being wasted in significant quantities (27).

Martins ML et al. conducted a survey on 4th-grade pupils from 21 schools in Porto, Portugal. The study found that the presence of teachers in the canteen reduced food waste. Additionally, when students were allowed to leave the canteen whenever they finished eating, food waste was further reduced. Extending the lunch period from 20 to 30 minutes also helped minimize waste (28). Similarly, having a recess before lunchtime contributed to lower food waste (28). When food palatability improved and portion sizes were reduced, children ate more and wasted less. The study revealed that fish dishes were the most wasted, while soups without lentils or blended soups were consumed more and wasted less. Food waste was directly proportional to the number of children present in the canteen at a given time. Additionally, children who had high-fat mid-morning snacks before lunch tended to waste more food on that day. A 2005 study further found that when more competitive and

appealing food options were available, children tended to waste more of the food served on their plates (29). However, most of these factors have been studied independently rather than in combination. Analyzing their combined impact on plate waste could be instrumental in developing effective strategies to reduce it. Many parents are unaware of the negative effects of food waste, and even those who recognize the issue often struggle to address it due to a lack of knowledge on how to manage their children's food preferences. Similarly, at school, teachers often lack the resources or strategies to educate children on reducing food waste during school lunches. In this context, pediatricians play a crucial role in coordinating efforts to reduce food waste, involving parents, caregivers, teachers, and children in the process.

SPECIFIC PROGRAMS TO REDUCE FOOD WASTE

Various awareness campaigns targeting key players in food waste prevention have shown promising results. One such initiative was conducted at the School of Agriculture canteen, University of Lisbon, Portugal, and proved effective in reducing food waste (30). The education and collaboration of canteen staff played an equally important role as consumer awareness in this program. Several universities and organizations have launched awareness programs, particularly targeting children. Outside2Inside, a non-governmental organization in Silicon Valley, Santa Clara, California, USA, works with children to prevent, recover, and recycle food waste through creative initiatives (31). Eurokids Preschool has also introduced training programs for toddlers to teach them about food waste prevention (32). Top universities and governmental/non-governmental organizations worldwide have introduced courses and workshops (both online and offline) to educate consumers on reducing food waste. These programs often include climate change awareness, highlighting its negative impacts and steps to mitigate them (33). Additionally, various resources have been developed to assist both consumers and restaurant staff in significantly reducing food waste. The United Nations has designated September 29 as the *International Day of Awareness of Food Loss and Waste*. On this day, global events are organized to educate people on food waste reduction, promoting both food security and environmental sustainability (34). The Environmental Protection Agency (EPA) of the United States has developed a toolkit to guide organizations in designing social marketing campaigns and customized materials to encourage behavioral change in target populations (35). Certain companies, such as Novozymes in Denmark, are actively researching and developing food additives that safely extend shelf life, thereby reducing food waste. Their goal is to optimize food systems to maximize resource utilization (36). Local food banks and food-sharing programs have also emerged as effective solutions to combat food waste. Collaborations at local, national, regional, and international levels

can further enhance these efforts. Case studies on food waste prevention partnerships have demonstrated excellent outcomes (37). However, greater opportunities exist to improve both human health and environmental sustainability. To capitalize on these opportunities, there is a need for efficient resource utilization, trust-building, and overcoming logistical challenges. Regular data collection and further research in this field will be crucial to advancing these efforts.

ROLE OF PAEDIATRICIANS IN PREVENTING FOOD WASTE: THE SOLUTIONS

Food waste reduction at the household level

Pediatricians manage childhood diseases and provide guidance on feeding. Parents often approach them with concerns that their child is not eating adequately or is refusing healthy foods. While advising parents on how to handle a fussy eater, it is also important for the physician to make them aware of ways to reduce food waste and its significance. Parents and caregivers often need support in feeding their children. By making mealtime and food planning engaging, they can help reduce food waste. When children eat better, this naturally results in less food being discarded. Some of the ways that parents can ensure this are as follows:

1. Holding food challenges: Rewarding a child who finishes their entire plate without waste reinforces healthy eating habits.
2. Introducing disliked foods gradually: Start with small amounts and increase them over time to help children overcome food neophobia. Another approach is masking the bitter flavor of vegetables with sweet ingredients to make them more acceptable.
3. Making meals visually appealing: Preparing food in various natural colors and different shapes, such as geometric patterns or favorite cartoon characters, encourages children to eat more and waste less.
4. Serving appropriate portion sizes: Give children only the amount they can comfortably consume, adding more if needed. Teaching self-serving practices can also help.
5. Offering easy-to-eat foods: A study from Cornell University found that children consumed more apples when they were sliced rather than served whole (38).
6. Avoiding pre-meal snacks: Skipping snacks before meals increases hunger and reduces food waste.
7. Using creative food names: Giving foods funny or engaging names can make meals more enjoyable for children, increasing their appetite. However, a Cornell study supporting this tactic was later retracted due to concerns over data integrity (39).
8. Saving leftovers properly: Store leftovers correctly, reheat them if necessary, and be mindful of foods that should not be reheated. By packing lunchboxes with

nutritious food that the child likes. Encourage the child to finish it. Pack the lunchbox properly to avoid spillage and spoilage. Pack only in amounts that parents know their child can finish. Request that the child bring the unfinished food back home.

9. Involving the child in picking up grocery items, fruits, and vegetables. Also, include the child in food planning, preparation, and lunch packing.
10. While traveling, cook and pack wisely. Choose foods that do not spoil at room temperature and have a longer shelf life.
11. By educating the child about food nutrition, how foods are grown, and their cost.
12. By discussing with children the negative effects of food waste. However, a study showed that children are already sufficiently aware of food waste and its harmful consequences and can regulate their intake accordingly (40).
13. A Japanese study by Kawasaki Y et al. suggested that meal-related rituals to express gratitude for food can also reduce food waste (41).
14. Parents can reduce food waste by making proper grocery lists and following the 'first in, first out' principle for foods stored in the pantry or refrigerator. Purchase only what is needed and ensure the family can finish it. Understand the difference between 'Use before' and 'Best before' dates on perishable food items. Reheat and eat leftovers, or donate them to people in need. Use smell as an indicator to check if food is still edible. Leftover food can also be fed to stray animals like dogs and cats or repurposed for industrial use (e.g., making oils). Composting organic waste helps reduce greenhouse gas emissions and minimize landfill volumes.

Food waste mitigation strategies at schools

At schools, one can adopt ‘smart lunchroom strategies’ to cut down on food waste. Train canteen employees and cooks in the proper cutting of fruits and vegetables and cooking techniques. Food should be tasty and palatable, in addition to being nutritious. Taste and nutrition need not be exclusive, as revealed by the studies carried out in Carolina schools. These studies showed that the adoption of a healthy food policy in schools did not increase plate waste (20). The introduction of new, novel recipes, a decrease in serving size, and the reduction of fats, sweets, and side dishes with lunch led to less food waste in the study by de Souza VR et al. (42). Provide children with foods that are easy and fun to consume. A recess scheduled before lunch increases appetite and focus on eating. Increase lunchtime to 30 minutes. Involve students in school meal programs. Encourage children to eat and assist them in doing so. Elnakib SA et al. conducted a pre- and post-test study to evaluate whether training sessions and smart lunchroom strategies helped in food waste mitigation in

schools in the Northeast of the USA. The non-controlled trial showed that the intervention did assist in total and specific food loss reductions (43). However, not all schools and preschool centers used these policies and interventions to help children eat healthily and reduce waste. But those schools that employed the promotional strategies reported less food waste. This reduction was proportional to the number of strategies implemented (44). Another 3-month follow-up study from Portugal showed that child intervention to mitigate food waste was effective for a short time, while interventions directed at teachers yielded medium-term benefits (45).

Food waste reduction at eating houses

At restaurants, one can opt for shared menus, and packing up leftovers after eating can reduce waste. All the measures used should focus on nutritional enhancement without risking planetary well-being.

CONCLUSION

The solutions to overcome food waste are simple and practical. Small lifestyle changes can make a significant impact, helping to feed the hungry, save money, and protect the environment. Most parents and consumers are unaware of the scale and impact of food waste globally. It is the responsibility of everyone involved in patient care, particularly pediatricians, to educate caretakers, parents, and teachers about this issue. Taking small steps in this direction can yield long-term social, economic, and environmental benefits.

KEY POINTS

1. Food waste is a global crisis with environmental, economic, and health consequences.
2. It contributes to social, public health, and planetary challenges.
3. Households with children generate more food waste than those without.
4. It is the responsibility of all those involved in patient and child care to raise awareness among parents, caregivers, teachers, and children about the magnitude of the food waste issue, its negative effects, and the solutions to reduce it.
5. Small, consistent efforts can lead to significant long-term improvements.

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