

Preventing Childhood Obesity: Government Policy, Prebiotics, and Education in School Lunch Programs

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Abstract

Rates of childhood obesity have been rising for almost half a century. Causes, although varied, can be summed up into genetic, lifestyle, and environmental factors. Schools play a large role in impacting students' dietary and lifestyle choices, so our proposed solutions stem from the school-level. Various research papers were reviewed and analyzed in order to come to a solution that satisfies the complexity of childhood obesity from the care of schools. These covered a large spectrum of topics, from different perspectives such as the scientific and political sides. Through analysis of these research papers on topics like prebiotics and the Healthy, Hunger-Free Kids Act of 2010 (HHFKA), solutions were developed. Among the solutions developed were changes to education programs, meal options, and government regulations. These have been shown to be effective in reducing obesity rates, across various studies and reviews. Research has been compiled from various sources to provide comprehensive evidence to these solutions. Our solution is multifaceted, with suggestions across categories such as food choices and health curriculums. Prebiotics were shown to have a positive effect in reducing the risk of contracting childhood obesity. Programs like the HHFKA were shown to be effective in their goals. Additionally, further health education classes demonstrated a positive effect. The solution was formed based around these findings. The proposed solution connects with the United Nations' Sustainable Development Goals, with an overall goal of reducing childhood obesity all over the world. This solution is compiled into a proposed government policy that would ensure support for student health through the various mentioned programs, and should be considered in countries across the globe.

Introduction

Childhood obesity is a serious chronic condition affecting children and adolescents, defined as having a body mass index (BMI) in the 95th percentile or higher (National Heart, Lung, and Blood Institute, 2022). The obesity rate is three to four times higher than it was in the 1980s and continues to rise (Veugelers & Fitzgerald, 2005). Numerous factors contribute to obesity in children, including genetics, nutrition, and lifestyle (Mayo Clinic, 2022). While genetics cannot be controlled, children must be encouraged from a young age to prioritize healthy lifestyles and nutrition.

Across the world, childhood obesity has seen a sharp increase. More than 390 million children between the ages of 5 and 19 (school aged children) were categorized as overweight in 2022, and the rate of school age children who were overweight rose from 8% in 1990 to

20% in 2022 (World Health Organization, 2024). Similarly, obesity rates have also increased significantly in that time frame. The fact that it is so widespread only adds to the difficulty in solving this issue, as the circumstances surrounding obesity in each country differs.

We researched studies about prebiotics and their effect on obesity. Implementation of prebiotics into obese children's diets have been proven to reduce their body fat and weight (Nicolucci et al, 2017). We researched the effects of education programs for childhood obesity action and awareness and their efficiency, as well as government action on children's meals in schools and health education.

This paper focuses on the role schools play in children's health and the changes they can implement to create a healthy environment for students. The purpose of this literature review is to show how childhood obesity can be fought through the school lunch system as well as other school-based programs with substantial evidence.

Problem Statement

Schools are largely overlooked as possible facilitators of change when fighting childhood obesity. Our paper focuses on working towards fighting childhood obesity through school meals and education. We acknowledge that the issue is multifaceted and complex, therefore effort being concentrated on one area of society would only address one side of the issue. However, with children spending six to seven hours per day at school focus must be placed on that area of children's lives (National Center for Education Statistics, 2008).

With this issue being addressed, we would also be addressing three of the seventeen United Nations Sustainable Development Goals (SDGs). These include 1) Good Health and Wellbeing, 2) Quality Education, and 3) Peace, Justice, and Strong Institutions, which are their third, fourth, and sixteenth SDGs, respectively (United Nations, n.d.).

The United Nations Sustainable Development Goal of Good Health and Wellbeing is the first one that will be a primary focus in this paper. The primary mission statement of this goal involves promoting healthy living for everyone everywhere. This ties into the problem at hand, with the demonstrated negative consequences of obesity showing detrimental effects to health and wellbeing. At the same time, costs for healthcare are rising to the point that 381 million people worldwide are living in poverty (United Nations, 2023a). This is why finding a solution is complicated.

The second SDG that this solution will be focusing on is Quality Education. With the large portion of a day spent in schools, children rely on what they are taught for making decisions with their lifestyle. They are influenced by the content of classes, as classes are responsible for teaching students about more than just history or math. Part of achieving a quality education for all is not just making education accessible, but also the "quality" part of it. If schools either play a neutral or negative role in influencing students' eating and lifestyle choices, they are failing to provide a quality education.

Peace, Justice, and Strong Institutions is the last SDG we will be focusing on. This is where the government is important to the health of students. This goal involves the schools and

government being effective at what they do, and what they do needs to be what is best for their people (United Nations, 2023b). This is why the government is an important part of the problem of childhood obesity in schools. For the government to be succeeding at the sixteenth SDG, they must play a part in resolving this problem.

Our proposed solutions directly address each of these goals. Childhood obesity in schools requires focus on all three of these goals, and through focus on each of these individually, the problem can be better addressed. The end result of this paper is to find a way to effectively reduce the trend surrounding childhood obesity, within a school-based setting, and help achieve a more sustainable future and a healthier, happier population.

Methods

Throughout our research process, we were able to access a variety of resources. Our main research resource was the Virginia Tech Newman Library. Over a two week span, we went to the Newman Library three times to receive assistance from two Virginia Tech librarians, Ms. Kirsten Dean and Ms. Kiri DeBose.

With their help and granted access, we used databases like Google Scholar and EBSCO's Academic Search Complete. When searching, we used terms like "Pediatric obesity" and "Childhood obesity in schools". We were able to find relevant sources to childhood obesity in school lunches after broadening our search inputs. To try to determine the relevance, we read the abstracts first. Through this process, we obtained a general understanding as to whether or not the journal articles we were reading were pertinent to the topic. Many articles would have titles that were misleading and required further reading. By using the abstracts, the results were narrowed down to only the truly relevant ones. Once we knew which journal articles were relevant, whether they were reviews or original research, we began to gather information. Review articles were useful for gathering general background information, rather than actual analyzable results. The original research articles are where the majority of the data analyzed below came from. These ranged from surveys, to formulated models, with many other varieties of studies in between. We collected notes from each article, with notable pieces of evidence and the main takeaways from each article. As a group, we sorted the articles into the different solutions which they support. While doing this, we found some articles were isolated in their ideas, and not highly corroborated. In order to find more evidence backing up the ideas of those papers, we went back to the research process to find possible corroborating sources. Following our research process, we began formulating our paper with our research and analysis, with a final solution proposal.

Background

Childhood obesity affects one in five school-aged children in the United States (Centers for Disease Control and Prevention [CDC], 2022). People who are obese are more likely to suffer from other conditions in the future; the occurrence of hypertension, cardiovascular diseases, type 2 diabetes, and other diseases all dramatically increase in the presence of obesity (Veugelers & Fitzgerald, 2005). Childhood obesity is a complex issue with many causes. In the context of schools, not all of these are addressable. However, factors such as lunch options are within the control of schools. There are many things schools can do to change how school

lunch programs are executed currently. As such, it is important to determine which changes work and which do not. Childhood obesity cannot be solved by a singular way of thinking. It is an issue of environment, food availability, education, and a multitude of other factors; many different potential solutions must be looked at.

Education Programs

Education is also a large portion of the childhood obesity problem. Without proper education, lifestyle changes will not happen. Schools play a large role in the development of students from the age of 5 to 18. Not only do many students depend on schools for providing breakfast and lunch, but also for learning about the food they eat. Some schools have nutrition lessons as part of their curriculum—the USDA’s MyPlate infographic can be found on classroom walls across the country, for example—but the MyPlate way of thinking has come with serious criticism. The diagram fails to mention healthy fats and oils or nutritional information, as well as not listing any numerical portion sizes to follow (Nutrition Source, 2024). With the large impact schools play on students’ diets and nutrition, it is important to determine the effectiveness of schools’ food education programs.

Education systems for the prevention and intervention of obesity in children have shown promising results. One study showed that using a multi-leveled approach with a heavy focus on nutrition education helped children to make a change towards a healthier future. Pineda et al. implemented a search strategy where they gathered a wide range of data involving demographics and resulting data from other studies. Notably, Pineda et al. managed to gather data from beyond just the United States. The variety of different studies that they investigated had mostly positive effects. There were positive effects in the US, Italy, Australia, Norway, Peru, and other countries. Beyond just determining the effectiveness of the programs, it was determined which specific types of programs were the most successful. Nutrition education programs proved to be the driving factor in obesity reduction. In the study, nutrition classes and physical education classes were shown to help reduce obesity in the not just the immediate future, but also into adult life as well (Pineda et al., 2021).

A study by Verotti et al. focused on interventions featured in schools, such as health education, physical education classes, and the educators themselves. The study examined prior research done on the various educational techniques to determine their results and efficacy. Some of the programs that were looked at included education on water consumption, health education lessons, physical activity, and combinations of those programs. From these programs, data was taken on the participating students. Physical activity programs were accompanied by decreases in body fat percentage, as well as BMI and skinfold thickness. Water consumption education programs showed no actual decrease in BMI; however, there was a decrease in obesity risk factors. When nutrition education programs and physical activity programs were combined, participating students saw lower rates of obesity and overweight (Verotti, et al., 2014). Overwhelmingly, the programs studied by Verotti, et al., showed a decrease in obesity rates, as well as decreases in overall BMI in some cases.

Prebiotics

Prebiotics are compounds that facilitate healthy activity of bacteria within a person’s

gastrointestinal tract. There are many food items in which prebiotics are naturally abundant. Prebiotic fibers can be supplemented through synthesized substitutes. For example, in bakery and dairy products, prebiotics have been used as flavorings and emulsifiers. Inulin has been used in sausage and cheese as a fat substitute (Boland, 2023). Prebiotics can be used as a healthy alternative to fats and additives without considerably changing the taste or texture. Adding fiber to foods that already exist on menus might generate more support as it would be a gradual change to children’s diets at school. It has been proposed that adding 2.5 to 6.5 grams of prebiotics per serving in food leads to double or triple one’s fiber for beneficial effects (Boland, 2023).

Nicolucci, et al. conducted a study to test the effectiveness in using prebiotics to reduce body fat in obese children. Participants were 7-12 years old and were previously diagnosed with childhood obesity. They were randomly assigned to groups, in which one was given oligofructose-enriched inulin (OI), a prebiotic, and another group was given Maltodextrin placebo for 16 weeks. The researchers measured the participants’ height, weight, and waist every 4 weeks. They collected blood samples of all participants and analyzed for lipids, cytokines, lipopolysaccharide and insulin, as well as fecal samples. Microbiota was analyzed by 16S rRNA sequencing and quantitative polymerase chain reaction.

Figure 1

Clinical evidence for prebiotics as a dietary intervention in childhood obesity

Study	Prebiotic	Study population and design	Gut microbiota	Inflammation	Entero-endocrine	Others	Adiposity, lipid and glucose metabolism
Abrams et al. (2007)	Oligofructose-enriched inulin	US; 9-13y (N=97); 8 g/d for 48 w	N.D.	N.D.	N.D.	Increased accretion of calcium to the skeleton	Smaller BMI increase
Liber and Szajewska (2014)	Oligofructose	Poland; 7-18y (N=97); 8 g/d of for 7-11 y and 15 g/d for 12-18y for 12w with dietary advice and PA	N.D.	N.D.	N.D.	N.D.	No effect on body weight
Zhang et al. (2015)	Mixed prebiotics	China; 3-16y (N=38), grouped by simple obesity (SO) or Prader-Willi syndrome (PWS); whole meal replacement with prebiotics for 4w (SO) or 12w (PWS)	Increased <i>Bifidobacterium</i> spp. and enhanced carbohydrate metabolism	Reduced inflammation	Reduced leptin and increased adiponectin	Reduced urine levels of TMAO, indoxyl sulfate, phenylacetylglutamine and hippurate	Reduced BMI, improved liver condition, lipid and glucose metabolism
Hume et al. (2017). Nicolucci et al. (2017)	Oligofructose-enriched inulin	Canada; 7-12y (N=42); 8 g/d of prebiotic for 16w	Increases <i>Bifidobacterium</i> and reduced <i>Bacteroides vulgatus</i>	Reduced inflammation	Increased fasting ghrelin and adiponectin	Increased satiety and levels of primary bile acids	Reduced BMI z-score, body fat and trunk fat, serum triglycerides
Zalewski and Szajewska (2019)	Glucomanan	Poland; 6-17y (N=81); 3 g/d of glucomanan for 12w with dietary advice and PA	N.D.	N.D.	N.D.	N.D.	No effect on weight reduction; improved lipid metabolism
Visuthranukul et al. (2022)	Oligofructose-enriched inulin	Thailand; 7-15y (N=155); 13 g/d of prebiotic for 24w with dietary advice and PA	N.A.	No difference between study groups	N.D.	N.D.	Increased fat-free mass index

Note. Table represents a compilation of results from various studies on the usage of prebiotics to reduce childhood obesity (Wang et al., 2023).

The results showed that after sixteen weeks, children who had consumed the OI had a weight reduction of 3.1%, body fat reduction of 2.4%, trunk fat reduction of 3.8%, and a 19% reduction in serum triglycerides. There was also a placebo tested to ensure the validity of the results. For the children who received the placebo, there was an increase in fat mass, and little to no change in body fat percentage and trunk fat percentage, among other tested values. This demonstrated the comparative effect of the prebiotics, as receiving a placebo actually increased

fat mass for children (Nicolucci et al., 2017).

Figure 1, shown below, provides insight to the various studies that have been done on the topic. There are varying results across various aspects of health. Although not all of the studies referenced in the chart show a reduction in weight or body fat, it is a notable result that exists, especially with the use of Oligofructose-enriched inulin. According to *Frontier in Nutrition*, green banana flour has shown a significant impact as a prebiotic due to the ability to promote gut health (Baek et al, 2023). To conduct the experiment, mice were given different doses of green banana flour everyday for three weeks. Then, they collected fecal samples on days 1, 14, and 21 for microbiota analysis. After 21 days, the composition of intestinal microbiota was significantly altered with an increase in beneficial bacteria. These changes enhanced biological processes related to amino acid biosynthesis and metabolite production when reducing processes related to carbohydrate and glycerol degradation (Baek et al., 2023).

Similarly, chicory root fiber has shown efficiency in supporting healthy weight management particularly in children (Crane, 2015). Over a 16-week period, children who consumed 8 grams of chicory root fiber daily showed significant changes in body loss in body mass index (BMI) compared to a control group. This change in BMI was attributed to the children who consumed an average of 84 calories or less at a final breakfast buffet compared to the placebo group. The good taste and ease of integrating chicory fiber put into daily diets may enhance its potential as a tool in the fight against childhood obesity (Crane, 2015).

The combination of green banana flour and chicory root fiber could provide a synergistic effect that helps to prevent childhood obesity by promoting gut health and reducing calorie intake in children.

State-Sponsored Nutrition Programs

One form of prior action has been government policies. These come in different forms, such as restrictions on the types of foods allowed, providing additional funds for school meal programs, or even direct control over school meal menus. These kinds of programs have been implemented all over the world, but programs specifically in the United States and Canada will be looked at below.

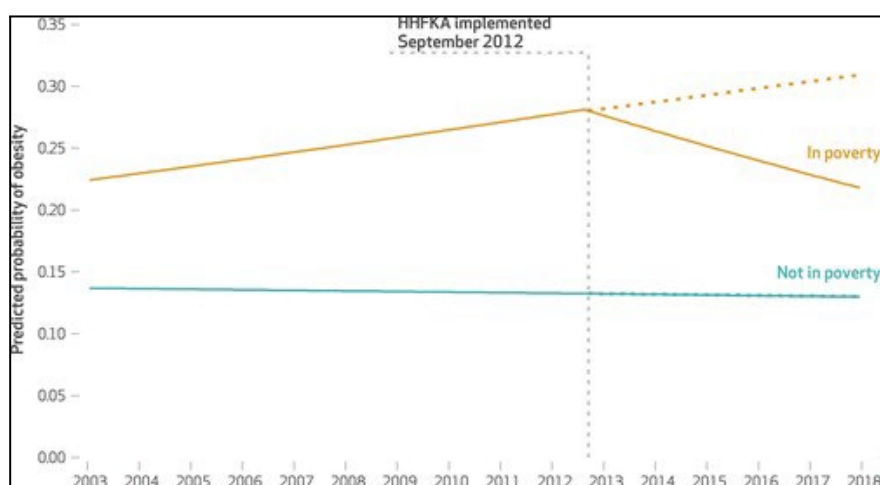
In 2010, the Healthy, Hunger-Free Kids Act (HHFKA) was enacted by President Barack Obama. The law was an important step in food assistance for students as it served programs like the National School Lunch Program and the School Breakfast Program. Many children already relied on these programs, specifically children from low-income families who needed free or reduced-price meals. By strengthening these programs, those children stood to benefit the most. The first provision of the HHFKA was putting school meal requirements into the hands of the USDA. Additionally, it increased the funding the government placed into school lunch programs. Among other important provisions were limits and requirements on certain food groups in school lunches. Fruit and vegetable servings increased, while starchy vegetables were reduced. Furthermore, there were adjustments to the products available, such as switching to low-fat and fat-free milks and implementing more whole grains on school lunch menus. Lastly, the HHFKA mandated serving sizes to vary by age (Kenney, et al., 2020). Most importantly, these standards were among the first to follow strictly science-based

guidelines. In this case, the guidelines were set by the National Academy of Medicine.

A study conducted by Kenney, et al. sought to find the effectiveness of the HHFKA in reducing childhood obesity in schools. Kenney's study looked at obesity trends among children between the ages of 10 and 17 from 2003 to 2018. The study took a specific focus on the change from the pre-HHFKA years (2003-2009) to the post-implementation years (2010-2018). The study found that the HHFKA had no impact on both the risk of childhood obesity and in the actual likelihood of having childhood obesity (Kenney et al., 2020). However, the study did find that there were effects on a more specific group of people. For the impoverished, prior to HHFKA, the risk of childhood obesity had been consistently increasing, but the trend entirely reversed after the implementation of HHFKA, shown on Figure 2 below (Kenney, et al., 2020). Importantly, Kenney noted that they could not account for some schools not participating in the program.

Figure 2

Predicted probability of obesity among youth ages 10-17 before and after implementation of Healthy, Hunger-Free Kids Act, by poverty status



Note. Graph shows the trend in probability of contracting childhood obesity between 2003 and 2018. General decrease after implementation for children in poverty (Kenney et al., 2020).

In 2018, it became more difficult for full implementation of the HHFKA. President Donald Trump's administration expanded the timelines for full implementation of requirements for sodium, whole grains, and milk. Specific details of the extended deadlines are shown below on Figure 3, as well as the original deadlines. This was partly because of the immense costs to schools for adding healthier foods (Kogan, 2019). The USDA also stated that the new standards were difficult to attain, despite similar programs having been implemented at almost 100% compliance rates (Kogan, 2019).

In 2003, similar research was done in Nova Scotia, Canada, by Veugelers & Fitzgerald. A survey was taken, with 5th grade students as the survey pool. The study collected

information about weight, diet, and physical activity among students, which was then divided into two groups. One group was for students in schools that followed nutrition programs, while the other group was for students in schools without nutrition programs. The results of the survey showed lower rates of childhood obesity among children that were at schools that participated in nutrition programs (Veugelers & Fitzgerald, 2004).

Figure 3

Difference Between 2018 and 2012 Final Rules

	Obama Final Rule (2012)	Trump Final Rule (2018)
Sodium	<ul style="list-style-type: none"> • Meet Target 1 by SY 2014-2015 • Meet Target 2 by SY 2017-2018 • Meet Target 3 by SY 2022-2023 	<ul style="list-style-type: none"> • Meet Target 1 by SY 2023-2024 • Meet Target 2 by SY 2024-2025 • Eliminates Target 3
Whole Grains	<ul style="list-style-type: none"> • Half of grains must be whole grain-rich by July 2013 • All grains must be whole grain-rich by July 2014 	<ul style="list-style-type: none"> • Half of grains must be whole grain-rich indefinitely
Milk	<ul style="list-style-type: none"> • Allows only fat-free or low-fat milk and fat-free flavored milk to be served beginning January 2012 	<ul style="list-style-type: none"> • Allows fat-free or low-fat flavored and unflavored milk

Note. Lists the changed standards and deadlines between 2012 and 2018. Many of the deadlines are pushed back (Kogan, 2019).

Solutions

Our proposed solution is a government policy proposal that consists of the implementation of two programs: one for educating students and families, and one for the revision of school nutrition, specifically within science-based guidelines and suggestions. This policy should be looked at and some similar programs should be implemented in countries across the world.

Education Programs

The first branch of our program would be an education program that provides schools with government-funded research from scholars about nutrition for school-aged children. Schools would be required to include a nutrition and food health unit in their health and physical education curriculum. This would ensure that every child is being educated on the importance of health and food choices. Schools would also be encouraged to share the information with parents via brochures, family lessons, and online resources. This goes in hand

with the research done by Verotti et al. on various school health programs. With the finding that combinations of different programs like health classes, physical activity, and water consumption education tend to produce positive results in reducing obesity, these programs should be expanded to all schools (Verotti et al., 2014). Many schools still fail to provide these types of programs and so in order to obtain reductions in obesity in all schools, all schools should provide students with these basic education programs (Centers for Disease Control, 2016).

Verotti et al.'s research can be coupled with the research done by Pineda et al. Nutrition education not only applies to students, but also to the school employees responsible for the care of the students for 6 hours a day, such as chefs, teachers, and parents. The highest level of effectiveness in reducing obesity came from having the most opportunities available for education, which fostered a healthy nutrition-based community (Pineda et al., 2021).

Perhaps the most important finding from Pineda et al. was the effect that education has on food choices. A changed environment and culture surrounding food drove changes to the food choices that students ended up making (Pineda et al., 2021). This emphasized the multifaceted nature of this proposed solution. If the different solutions can help make each other more achievable, then it becomes much more possible to reach the end goal.

This branch of the solution would work toward the UN's Quality Education Sustainable Development Goal, as it would provide the public with thorough information about the topic. It would be provided to everyone, regardless of their gender, race, status, etc and would be constructed from reliable research. As health and nutrition education programs work in a variety of countries, with varying obesity risk factors present (Pineda et al.), the United Nations should push these programs as a part of their work for providing access to a quality education.

Prebiotics

Prebiotics, as previously discussed, have been proven to make a positive impact on obese children's health. We propose that as part of our solution, prebiotics should be added to school lunches. The implementation of this could be the change of menu items or the change of ingredients in items.

There are various types of prebiotic food that have inulin, fructooligosaccharides, galactooligosaccharide, resistant starch, dietary fibers and beta-glucans. Onion, garlic, leeks, asparagus, Jerusalem artichokes, and chicory root contain inulin and fructooligosaccharides. Galactooligosaccharide are present in vegetables, grains, and legumes such as beans and lentils. Resistant starch can be found in bananas, oats, legumes grains such as potatoes and rice. Dietary fibers are in fruits that are rich in soluble fiber such as apples, berries, and citrus fruits. Beta-glucans can also be found in grains such as oats and barley. Consuming prebiotic-rich food supports diverse and healthy gut microbiomes that are beneficial for overall health. To prevent childhood obesity, it's important to choose foods that are rich in prebiotics. The foods that are most rich in prebiotics are acacia gum, chicory root, Jerusalem artichoke, and dandelion greens. They also include inulin and are high in Vitamins A, C, and K (Boland, 2023).

There are many ways to prevent childhood obesity. One of the effective ways is that school offers healthier and prebiotic-rich foods. Snacks such as banana chips and chicory root granola bars could lead to preventing childhood obesity. Dried banana slices that are naturally sweet and contain high concentration of prebiotic fibers (Baek et al., 2023).

Many countries across the world have the capacity to grow foods that contain prebiotics. Fruits and vegetables with prebiotics are abundant in different parts of the world, while different roots and fibers with prebiotics are also found all over the world. This works towards the UN SDG of Good Health and Wellbeing. To truly achieve this goal, there must be good health and wellbeing everywhere. This means that healthy foods must be accessible everywhere. As such, this is a vital part of the solution. In countries where it is difficult to grow food, cooperation with other countries is a necessity. As a whole, this solution will encourage people to make healthier food choices and create an environment that facilitates the wellbeing of citizens.

Expansion of State-Sponsored Nutrition Programs

The studies conducted by Veugelers & Fitzgerald, Kenney et al., and others showed overwhelming results in favor of government-run school lunch programs. Veugelers & Fitzgerald's study showed significantly lower rates of both obesity and overweight among students whose schools participated in health programs. This study was based in Canada, demonstrating the effectiveness of Canada's government policies. While the United States operates off of different guidelines than Canada, it is notable that Canada had success as early as 2003. If other countries' policies are successful, it is a good sign towards the United Nations's goal of Peace, Justice, and Strong Institutions across the world.

Kenney et al. studied the effectiveness of the Healthy, Hunger-Free Kids Act (HHFKA) of 2010 by observing changes to obesity rates both before and after the implementation. The results were mixed, with little to no change to obesity rates among the general population after the implementation of the HHFKA, but huge wide scale improvements among students from low income groups. As Kennedy et al. mentioned, they did not account for the variability of students and schools not complying with policies. In a review by Kogan, it was examined if the financial burden plays a part in this. While the School Nutrition Association expected a loss in revenue to over half of school lunch programs that met the new standards, it was reported that 84% of programs actually had rising or stable revenue (Kogan, 2019).

In order to continue to reduce rates of obesity in both the impoverished and the general population, it is necessary to expand current programs. The impact of the HHFKA needs to be expanded onto the general population. The first thing that must be done is the implementation of HHFKA into more schools. While many school meal program directors are skeptical and worried about losses to revenue, these fears must be allayed. This should come in the form of widespread publication of the studies that show the revenue growth from the majority of the school food programs. Specifically, the study conducted by the Robert Wood Johnson Foundation and PEW Charitable Trusts, "School Meal Programs Innovate to Improve Student Nutrition," (Mulkey, n.d.) as well as similar studies. These independent studies had favorable results of government policies.

New government policies should continue to follow scientific advice. With the success of the HHFKA, which followed strictly science-based guidance from the National Academy of Medicine (Kenney et al., 2020), new policies should make mandates based on the most recent scientific guidelines. Things like the adoption of prebiotics into school meals should fall into government policy, as well as school health curriculums. By doing this, compliance with health standards will be mandatory. Furthermore, stricter enforcement is needed. As the Trump administration laxed enforcement of the HHFKA due to monetary concerns (Kogan, 2019), the enforcement should be brought back up as monetary and revenue concerns are eased.

This part of our solution partners with the UN's sixteenth Sustainable Development Goal of Peace, Justice, and Strong Institutions. Adopting legislation for nutritious school lunches is an example of a strong institution. The government has a duty to its people, and it is strengthened when it is working for its people. Putting policies in place that improve the nutrition of students is a perfect way for the government and its institutions like schools to be strengthened. As the SDG works towards achieving strong institutions everywhere, not just a couple countries, it is important that the United Nations works to advocate for national governments to implement policies and laws that mandate healthier school lunches.

Conclusion

We researched and provided a comprehensive solution to schools' role in the management of childhood obesity. There were a variety of results found, on topics such as education programs, prebiotic foods, and state-sponsored nutrition programs. The solution was a proposed government policy that included mandates on education programs and nutritional need revisions to tackle two major areas of concern. This included specific actions such as expansion of current programs like the Healthy, Hunger-Free Kids Act, as well as implementation of prebiotics and other foods into menus that comply with official guidelines from health-focused organizations. The education programs would involve a mix of expanded physical activity times, in addition to lessons about food and water consumption. The solution of health education will enhance the effects of the other solutions, as students will gain a larger understanding of the choices they make and the effects they have. Extensive research showed the effectiveness of these solutions, and that is why it has been found necessary to mandate these solutions.

We then discussed adding prebiotics to foods in school lunches, which has been proven to reduce weight and body fat in obese children. We found that Chicory root and bananas are prebiotic-rich foods that could prevent childhood obesity. To further improve the nutritional value of school lunches, we also proposed the coupling of this with our suggested expansion of government policies. Strictly science-based nutrition standards in menus will play a large role in prebiotics working efficiently and seeing a reduction in childhood obesity. Throughout the process of proper research involving multiple studies and reviews, it became clear that the solution proposed is the best way forward.

However, there are still challenges in implementing such a solution. One such challenge is with implementation. As policies like the Healthy, Hunger-Free Kids Act of 2010 are struggling to be enforced, the task will only get more difficult for other countries to implement similar policies. Even if the United States is able to set an example and reach full

adoption of the HHFKA and these new proposed policies, other countries still face barriers. Least developed countries (LDCs) have problems such as low income and environmental disasters. With much of their government focusing on solving these problems, childhood obesity often takes a backseat on the list of priorities. Furthermore, many nations might worry about the financial commitment to solving childhood obesity.

For the proposed solution to be maximally effective, international cooperation is needed. This goes back to the United Nations Sustainable Development Goals. Most countries cannot reach these goals on their own, and so countries need to help each other out. The solutions of expanding current policies and implementing new ones that enforce education programs and healthier lunches are complicated. However, these solutions are ones that can be put into place with cooperation and work with the United Nations and their SDGs. Given some time and a sharing of resources between countries, this is a strong framework for lowering the rate of childhood obesity across the world.

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