The Childhood Energy Gap

Using statistical modeling to quantify the childhood energy gap and its contribution to the increase in childhood obesity, and to identify effective obesity-reduction strategies

SUMMARY

A team of researchers used statistical modeling techniques to quantify the childhood “energy gap” and examine the gap’s contribution to the nation’s rapid rise in childhood obesity. Energy gap is shorthand for the imbalance between the number of calories that children take in daily through food and drink and the number they need for physical activity, normal growth, and body function.

The researchers, co-led by Harvard School of Public Health Professor Steven L. Gortmaker, PhD, and Columbia University Mailman School of Public Health’s Y. Claire Wang, MD, ScD, used their energy-gap analysis as a framework to project future childhood obesity levels and set targets for reducing calorie intake to meet federal obesity-reduction goals. The framework gives policymakers a common metric for estimating the caloric impact of eating and physical activity interventions, helping them decide among different approaches to childhood obesity prevention.

The project, which spanned the years 2004–13, had a significant impact on efforts of the Robert Wood Johnson Foundation (RWJF) to reverse the childhood obesity epidemic, says Tracy Orleas, PhD, senior scientist at RWJF:

“The research identified interventions that could begin to turn this around ... What would it take? How could we do it? It has been critical in laying that out for us—and, I would say, in giving us the confidence that we could make a difference. It was no longer an overwhelming challenge. Now we know where to start.”—Tracy Orleas, RWJF

The project also included formation and support of a collaborative network of obesity modelers in Canada, England, and Australia as well as in the United States.
Key Findings

The project team published their findings in *Pediatrics*, the *American Journal of Preventive Medicine*, and other peer-reviewed journals. The following are key findings from a selection of these articles. (For more, see Key Findings & Recommendations in this report; for citations and links to the articles, see the Bibliography.)

- **Over a period of approximately 10 years, beginning in the late 1980s, U.S. children and adolescents overall experienced an average per capita energy gap of roughly 110 to 165 calories per day.** By the early 2000s, this gap led to an excess of 10 pounds of body weight for all adolescents—or one pound per year, on average.\(^1\)
  
  — U.S. *overweight* adolescents consumed an average of 700 to 1,000 more calories per day than required for normal growth, physical activity, and body function. Over the 10-year period, this gap produced an average of 58 extra pounds beyond the weight gain associated with normal growth—or, on average, an extra six pounds per year.

- **Based on past trends, the average weight of U.S. children and adolescents will increase almost four pounds by 2020 compared to 2007–08, and more than one in five children will be obese.\(^2\)**
  
  — To avert that increase, youth age 2 to 19 would have to reduce their energy consumption by an average of 41 calories per capita, per day.
  
  — To achieve the federal government’s obesity-reduction goal for the year 2020, youth would have to eliminate an additional 23 calories per day on average—for a total daily reduction of 64 calories.
  
  — Participation in a comprehensive physical education program could increase energy expenditure by about 19 calories per day among children age 9 to 11. Reducing TV time one hour a day could cut the energy gap about 100 calories per day.

- **Children and adolescents age 2–19 increased their caloric contribution from sugar-sweetened beverages and 100%-fruit juice from 242 calories a day in the period 1988–1994 to 270 calories a day in 1999–2004.** Youth got 10 percent to 15 percent of their total calories from sugar-sweetened beverages and 100%-fruit juice.\(^3\)

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**Key Results**

- The research team created a *caloric calculator*—a user-friendly online tool that allows policymakers, educators, and other stakeholders to assess a range of childhood obesity-prevention strategies.

- The project created an ongoing international network of researchers using computational and statistical modeling to monitor obesity trends and evaluate the impact of obesity-reduction policies in the United States and abroad. Network members focused on the causes and costs of adult as well as childhood obesity. They jointly reported on their work in a 2011 series of articles in the *Lancet*, which drew widespread notice in the popular media, helping to focus public attention on the obesity problem.

**Funding**

The Robert Wood Johnson Foundation supported this work with six grants totaling $1.34 million. Four of the grants went to the Harvard School of Public Health (which shared the funding with Columbia School of Public Health) and two to the nonprofit organizations—Academy for Educational Development (AED) and its successor FHI 360—that provided support services to the international network of obesity modelers. For grant details, see the Appendix.

**CONTEXT**

Childhood obesity increased rapidly in the United States in the late 20th century, alarming health care professionals and policymakers alike. By 2008 one out of every five children age 6 to 11 was obese—a threefold increase from the 1970s, according to the Centers for Disease Control and Prevention (CDC).⁴

Obesity—which is especially prevalent among certain ethnic and racial minorities—increases a child’s risk for many diseases and conditions that take a toll well beyond childhood, among them hypertension, diabetes, coronary heart disease, and stroke. As the Harvard School of Public Health states:⁵

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⁴ Obesity is defined by body mass index (BMI), a mathematical formula that assesses relative body weight. A child with a BMI at or above the 95th percentile of children of the same age and sex is considered obese. For a full explanation, see the CDC’s *Basics about Childhood Obesity*. A second document, *About BMI for Children and Teens*, is also helpful.

⁵ From the school’s website page *Child Obesity: Too Many Kids Are Too Heavy, Too Young*. 
“Obesity can harm nearly every system in a child’s body—heart and lungs, muscles and bones, kidneys and digestive tract, as well as the hormones that control blood sugar and puberty—and can also take a heavy social and emotional toll.”

**Energy Gap: A Key Factor**

In 2003 researchers led by James O. Hill, PhD, professor of pediatrics at the University of Colorado at Denver, published a study that translated weight increases in the U.S. adult population into estimates of energy gap—the gap between energy intake through eating and drinking and expenditure through activity.

There was, however, no similar analysis for children, which meant that, while the federal government’s health-promotion program, *Healthy People*, set goals for reducing childhood obesity, there was no yardstick for measuring progress. How much change in the youth population’s daily energy balance was necessary to reach *Healthy People* goals? Also missing was a common metric that researchers and policymakers could use to link obesity-reduction targets to policies and interventions with the potential to address the problem.

**RWJF’s Interest**

Achieving a healthy weight for America’s children, especially children of color and those in poor communities, is a major objective of RWJF. In 2007 the Foundation pledged $500 million to reverse what it termed the nation’s obesity epidemic by 2015.

Research to identify the causes of childhood obesity and effective prevention strategies was a key element of the RWJF efforts. Staff viewed science systems modeling as a means of enhancing this research effort. Science systems modeling, sometimes termed statistical modeling, uses mathematical concepts, historical data, and other tools to examine the interrelationship of variables in complex, real-world phenomena—and project how new policies and strategies are likely to impact outcomes.

RWJF’s earlier campaign to reduce the use of tobacco products, especially by young people, had benefited from this type of modeling, and “I knew it was a powerful tool for looking at issues involving major population change,” says Orleans. This report focuses on the childhood energy gap, which is a significant factor in obesity.


7 The goal of *Healthy People 2020* is to cut the percentage of obese children ages 2–19 by 10 percent—from 16.2 percent to 14.6 percent, the level in 2000. The program’s earlier iteration, *Healthy People 2010*, set a tougher goal: reducing childhood obesity to 5 percent, the level in 1970.
on the series of six RWJF grants that supported the application of modeling to the field of childhood obesity research.

**THE PROJECT**

Researchers led by Gortmaker, professor of the practice of health sociology at the Harvard School of Public Health in Boston, wanted to fill the void in estimating the childhood energy gap. “Simply put,” Gortmaker and a Harvard colleague wrote, “a child who eats more energy than [what is] needed for basic metabolic demands and growth and expended through physical activity will gain excess weight.”

Using statistical modeling techniques, the team quantified the childhood energy gap, analyzed its impact on youth weight levels, and evaluated the potential of population-level interventions to reduce childhood obesity. Y. Claire Wang, MD, ScD, associate professor at the Columbia University Mailman School of Public Health in New York City, worked closely with Gortmaker.

**Estimating the Childhood Energy Gap**

Gortmaker’s and Wang’s teams followed the general methodology that Hill had used to estimate adult energy balance but made adjustments to account for the fact that children, unlike adults, need some extra energy to support growth. In a nutshell, the team:

- Examined height, weight, and body mass index (BMI) data for a nationally representative sample of 5,000 children age 2 to 7 who participated in the National Health and Nutrition Examination Survey (NHANES) during the period 1988–94.
- Projected how the height, weight, and BMI of these children would change over the following 10 years based on normal growth patterns.
- Compared these normal-growth projections with the actual height, weight, and BMI data for a similar group of children and adolescents age 12 to 17 sampled by NHANES in 1999–2002. Thus, the two samples approximated a 10-year age span.
- Conducted additional analysis of the overweight adolescents in the 1999–2002 sample, including calculating the average excess weight accumulated by members of that subgroup.

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9 A graduate student at Harvard when the project started in 2004, Wang joined the Columbia faculty in 2007.

10 For a detailed description of the methodology, see Wang et al, “Estimating the Energy Gap.”

11 NHANES is an ongoing CDC survey that collects information on the health status of the U.S. population from a nationally representative sample through physical examinations as well as interviews.
Building on the Energy Gap Framework

Using the statistical framework developed to quantify the energy gap, the team predicted trends in BMI prevalence and analyzed a range of hypotheticals to identify policies and interventions with the potential to close the energy gap. The following are examples of the scenarios the researchers explored:

- If current trends continue, what will the BMI distribution be in 10 years among a cohort of children age 2 to 5? What percentage of the population aged 2–18 today will be obese by 2020? How do these projections vary by race/ethnicity and socioeconomic status?

- How would the projected trends in children’s body weight and underlying energy imbalance have to change to reverse the obesity epidemic?

- What would be the health impact on the population if sugar-sweetened beverages were eliminated or reduced from the diets of school-aged children? Or if TV-viewing by school-aged children were reduced an average of one hour per day?

Forming an International Modeling Network Through the National Collaborative on Childhood Obesity Research (NCCOR)

In 2007 Orleans, an NCCOR co-founder, teamed up with the Patty Mabry, PhD, representing the National Institutes of Health (NIH), Office of Behavioral Social and Sciences Research (OBSSR), to support Gortmaker and Wang in organizing an international network of systems science researchers. The researchers would use statistical and computational simulations to evaluate the population-level effect of childhood obesity-reduction interventions.

The network, known as COMNet (Childhood Obesity Modeling Network), included three teams in the United States, two in Canada, and one each in England and Australia. NIH co-funded the modeling network’s first two years with a $50,000 grant and provided continuing support for its expansion. In subsequent years, Terry Huang, PhD, and Regina Bures, PhD, secured co-funding from the NIH, National Institute of Child Health and Development and joined the NCCOR Envision project leadership team. (Envision coordinates and supports efforts that use statistical simulation models to assess the effectiveness of policies and interventions to reduce and prevent childhood obesity.)

The purpose of COMNet was to foster collaboration among dispersed researchers and thereby improve and validate their modeling approaches. In the first two years, its members met face-to-face five times and, in conjunction with two of the meetings (in Toronto and Washington), made public presentations on their work.
Working With Deakin University, Australia, on Cost Effectiveness

As part of the international effort, the Harvard researchers subcontracted with a team based at Deakin University in Melbourne, for assistance in adapting the Assessing Cost-Effectiveness in Prevention (ACE-Prevention)\(^\text{12}\) model to the United States. The five-year study had evaluated 20 obesity-prevention strategies—some targeting children, some adults—that ranged from nutrition/exercise education to gastric banding surgery. The Australian researchers calculated health impacts of the interventions in terms of BMI and net cost per disability-adjusted life year saved.\(^\text{13}\)

KEY FINDINGS & RECOMMENDATIONS

The Energy Gap and Its Role in U.S. Childhood Obesity

Quantifying the Energy Gap

In “Estimating the Energy Gap…” published in *Pediatrics*, Wang, Gortmaker, and the other researchers presented these findings:

- Over a period of approximately 10 years (1988/1994 to 1999/2002), U.S. children and adolescents overall experienced an energy gap of roughly 110 to 165 calories per day, on average. This gap led to an excess 10 pounds of body weight for all adolescents—or one pound per year, on average.

- U.S. overweight adolescents consumed an average of 700 to 1,000 more calories a day than required for normal growth, physical activity, and body function. Over the 10-year period, this energy gap produced an average of 58 extra pounds beyond the weight gain associated with normal growth—or, on average, an extra six pounds per year. Over time, these weight gains led adolescents to overweight status.

- “Quantifying the energy imbalance responsible for recent changes in weight distribution among children can provide salient targets for population intervention.”

  - The authors noted that reducing excess dietary intake may be easier to accomplish than increasing physical activity levels. As an example, they noted that a reduction of 150 calories can be achieved by cutting out one can of a sugar-sweetened beverage, but would require 1.9 hours of walking by a 66-pound boy.

  - Youth who have gained high levels of weight “will likely need changes in multiple behaviors and environments to close the energy gap,” the authors concluded.

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\(^{13}\) Disability-adjusted life year (DALY) is an established metric for the burden of disease.
**Setting Targets for Reducing the Gap**

In “Reaching the Healthy People Goals for Reducing Childhood Obesity” published in the *American Journal of Preventive Medicine*, the researchers presented the following findings:

- **To avert an ongoing increase in obesity, youth age 2–19 would have to reduce their energy gap by an average of 41 calories per day.** Based on weight increase trends during the period 1971–2008, the researchers predicted that the average weight of U.S. children and adolescents will increase almost four pounds by 2020 compared to 2007–08, and more than one in five children will be obese.

  — To achieve the federal government’s *Healthy People* obesity-reduction goal for 2020, youth would have to eliminate an additional 23 calories per day on average—for a total daily reduction of 64 calories per day.

  — Reaching the more stringent *Healthy People* 2010 goal (a level of obesity seen in the early 1970s) would require a total reduction of 161 calories per day from 2007–08 levels.

  — These energy gap reduction projections differ for specific age groups within the overall 2–19 age range: the younger the group, the smaller the energy gap.

- **“Increasing physical activity and reducing sedentary behaviors are clearly important strategies to restore youth energy balance,” the authors wrote.** They calculated the caloric impact of the following:

  — Participation in a comprehensive physical education program could increase energy expenditure by about 19 calories a day among children age 9 to 11.

  — For children in grades kindergarten through 5th, an afterschool program could increase their energy expenditures by 25 calories a day.

  — Reducing TV time one hour a day could cut the energy gap about 100 calories a day. The decrease results in part from a reduction in sedentary behavior but also from a reduction in eating associated with TV viewing and from exposure to food and beverage ads.

- **Targets are based on population-wide energy gap averages; children in racial and ethnic minorities and those living in low-income areas would need to make greater reductions.**

  — To meet the 2010 goal, for example, black youth age 12–19 would have to narrow their energy gap by 286 calories a day and Mexican-American youth by 201 calories a day—compared to 164 calories a day for whites.
Addressing Severe Obesity Among Minority Youth


- **Severe obesity is a problem especially among Hispanic boys and African-American girls**: 9 percent of Hispanic boys age 6–11 and 12.6 percent of African-American girls age 12–19 were classified as severely obese (1999–2006 data). (Severe obesity in children is defined as a BMI above 35 or at least 20% higher than 95% of other children of the same age and gender.)

- **Initiatives to prevent severe obesity among youth should have high priority.** Stepped-up surveillance, early detection, and targeted interventions are needed in light of the increase in prevalence of severely obese children and adolescents.

Focusing on the Role of Sugar-Sweetened Beverages

In “Increasing Caloric Contribution from Sugar-Sweetened Beverages,” published in *Pediatrics*, the researchers presented these findings.

- **Children and adolescents age 2–19 increased their caloric contribution from sugar-sweetened beverages and 100%-fruit juice from 242 calories a day in the period 1988–1994 to 270 calories a day in 1999–2004.** Youth now get 10 to 15 percent of their total calories from sugary drinks and 100%-fruit juice.
  
  — Adolescents got 67 percent of their sugary drink calories from soda, while preschool-aged children got the majority from fruit drinks.

- **Black and Mexican-American youth substantially increased consumption of these beverages while consumption by whites remained unchanged.**

- **On a typical weekday, American youth consumed more calories from sugary beverages at home (55–70% of total consumption of such beverages) than at school (7–15%).** This suggests that efforts to reduce intake on these beverages have to go beyond the school day.

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On the other hand, in Boston, self-reported student consumption of sugary drinks declined after the city’s school system banned vending machine soda sales in 2004. In a separate article, Gortmaker and colleagues reported on a school-based initiative to cut sugary drink consumption among Boston’s youth.\(^\text{15}\)

— Boston high school students surveyed in 2006 reported on average a daily consumption of 1.38 sugary drink servings—down from an average of 1.71 servings reported by students surveyed in early 2004, before the ban was implemented later that year. The drop represents a reduction of about 45 calories per day. Nationwide there was no significant change in adolescents’ sugary drink consumption during that period, according to NHANES data.

Based on the survey data, the authors concluded that an in-school restriction on sugary drink sales “may be a promising strategy to reduce adolescents’ intake of unnecessary calories.”

— Speaking about the ban to a Boston audience in 2011, Gortmaker observed, “The evidence is very clear. Kids reduced overall consumption per day by about 45 calories. That doesn’t seem like a lot, but our research shows that changes of this magnitude [are] just the level you need to start flattening out the obesity epidemic, if not to start turning it around.”\(^\text{16}\)

### Quantifying the Burden of Obesity in the United States and Worldwide

**The Lancet Series**

Based on current trends, the United States will have 65 million additional obese adults by 2030, and as a consequence an additional:\(^\text{17}\)

— 6 million to 8.5 million cases of diabetes
— 5.7 million to 7.3 million cases of heart disease and stroke
— 492,000 to 669,000 cases of cancer
— $48 billion to $66 billion a year in medical costs associated with treatment of these diseases


\(^\text{16}\) The talk is available on YouTube.

• **The more weight an individual gains, the more difficult it is to lose weight.** Consequently, Gortmaker and his colleagues say, “countries should focus on prevention” of excess weight in the first place—especially among children.18

  — Reducing the proportion of Americans with excess weight to the 1970s’ level would require a significant cutback in calories. To reach the Healthy People 2010 goal, the average American adult would have to reduce his/her energy gap by 240 calories a day over a number of years, based on realistic weight-loss calculations. For the severely obese, the reduction would have to be more than twice that.

  — A commonly cited weight-loss rule of thumb for adults—a reduction of 500 calories a day will produce a weight loss of about one pound a week—is overly optimistic because it fails to account for physiological adaptations to weight change.19

    Mathematical modeling of adult metabolism indicates this longer timeframe: A reduction of 10 calories per day will eventually produce a weight loss of about one pound, with 50 percent of the loss achieved in the first year and 95 percent in three years.

• **The global obesity epidemic over the last several decades appears to have been driven by changes in the world’s food system—specifically the production of “more processed, affordable, and effectively marketed food than ever before.”**20

  “The industry made it easier for people to consume more calories throughout the day,” Gortmaker told Jane E. Brody of the *New York Times.*21

• **The authors recommended that the United Nations and other international agencies play a stronger leadership role in the effort to reverse the global obesity epidemic.**22 The UN, its agencies, and member states should provide increased funding, policy support, and coordination to the prevention of obesity and other non-communicable diseases.

  — While recognizing that governments have the most important role in reversing the obesity epidemic, the authors noted that opposition from the food industry can


make it difficult for governments to implement priority food-related policies, such as labeling. More politically acceptable prevention measures—such as school actions, social marketing, and promotion of physical activity—may involve significant costs and yield uncertain benefits.

— A systems approach to obesity prevention is needed—a comprehensive, multi-faceted effort involving government, private industry, health care professionals, and individuals. Policies targeting the food and built environments plus additional resources for data forecasting and evaluation should be part of the effort.

**Adapting the Assessing Cost Effectiveness (ACE)-Prevention Cost-Effectiveness Model to the United States**

- **“An over-riding conclusion” of the Australian ACE assessment is that policy approaches to obesity prevention “generally show greater cost-effectiveness than health promotion or clinical interventions.”**23 Of the 20 interventions assessed by the Australians, the top three money-savers were:

  1. A tax of 10 percent on unhealthy food and beverages
  2. Front-of-pack, traffic light-colored (red, yellow, and green) nutrition labeling
  3. Reduction of junk food and beverage advertising to children

However, these interventions vary in evidence of effectiveness and “the likelihood of their implementation.” Neither advertising regulation nor labeling has drawn support from Australian policymakers.

- **The interventions found to be cost-effective in Australia may need to be modified for implementation elsewhere.** In the United States, instead of a 10 percent tax on unhealthy food and beverage, interest has centered on an excise tax on sugar-sweetened drinks alone. The evidence is “reasonably strong” that such a tax would be effective in reducing calorie intake plus it would raise billions of dollars in needed new revenues for the states.

  (In a 2010 draft manuscript detailing their ACE-Obesity America modeling analysis and in a presentation at the 2013 American Public Health Association meeting, Gortmaker and colleagues concluded that an excise tax of one cent per ounce of sugar-sweetened beverage implemented in the United States at the state level would reduce obesity-related morbidity and mortality, cut government health care spending, and raise substantial revenue that could be used for health promotion.)

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Limitations

The following were among the limitations on the findings cited by the researchers:

- **The “uncertainty” that goes with extrapolating from past trends.** While this is a limitation common to all population projections, childhood obesity trends for a number of reasons may be more “volatile” than adult obesity trends.\(^{24}\) In general, estimating the impact of population-level interventions “is far from precise and is confounded” by environmental differences and other factors.

- **The possibility that Boston students were influenced to reduce consumption of sugary beverages by factors other than the in-school ban on sales.** Local health promotion and nutrition education efforts independent of the ban could have been a factor.\(^ {25}\)

- **A possibility that some of the demographic and income groups in the NHANES samples were too small to ensure an accurate estimate of the prevalence of severe obesity.**\(^ {26}\)

RESULTS

- **The Columbia-based research team led the creation of a caloric calculator—a user-friendly online tool that lets policymakers, educators, and other stakeholders assess a range of childhood obesity-prevention strategies.**\(^ {27}\)

  Through a review of published obesity-intervention studies, the team developed a common metric—the Average Caloric Impact (ACI)—for estimating the impact of interventions on the energy gap of the nation’s youth population. Based on this metric, the team created a caloric calculator that won second place in the *American Journal of Preventive Medicine* Childhood Obesity Challenge.\(^ {28}\)

Here’s how it works:

— Click on one of four age groups (preschool through high school) and choose boys, girls, or both. The calculator shows how many excess calories per day must be cut to reduce that particular group’s obesity percentage from the 2009–10 level to what it was in 2000 and 1970, the *Healthy People* goals for 2020 and 2010 respectively.

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\(^{24}\) Wang et al. “Reaching the Healthy People Goals.”

\(^{25}\) Cradock et al. “Effect of School District Policy Change.”


\(^ {28}\) See Program Results Report on the competition.
— Next, select one or more of 15 evidence-based interventions and the intensity of implementation. For example, if reduced consumption of sugary drinks is the selection, the user chooses how much of a reduction: one 12-ounce can every day? Every week? Every month? Or a 20-ounce bottle daily, weekly or monthly?

— As the user moves through the selection process, the calculator tracks to what extent the accumulated intervention choices achieve the 2020 and 2010 goals for that age/sex group.

- In 2009 COMNet merged into Envision, resulting in a larger obesity modeling initiative that coordinates and supports modeling efforts worldwide. Members of the expanded network used modeling techniques to monitor obesity trends and evaluate the impact of obesity-reduction policies in the United States and abroad.

  — Envision includes two NIH networks of researchers and is part of the National Collaborative on Childhood Obesity Research (NCCOR). Funded by RWJF, NIH, CDC, and the U.S. Department of Agriculture, NCCOR coordinates and supports childhood obesity research of various methodologies, including modeling. Envision membership is limited to modelers who have funding from one of NCCOR’s four sponsoring organizations.

    As of 2014, Envision listed more than 50 affiliated modelers and about a dozen research projects. (See the Envision website for details of current operations, including the names of affiliated investigators.)

    — In 2011, members of the collaboration co-authored a series of four articles in the Lancet that examined the global obesity epidemic as well as adult obesity in the U.S. and certain other countries (see The Lancet Series).

**SIGNIFICANCE OF THE PROJECT**

The energy gap framework developed by the Harvard/Columbia teams gives researchers and policymakers a common metric for identifying the impact that changes in diet and physical activity have on the nation’s youth population and thus facilitates comparison of different approaches to obesity prevention.

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28 With COMNet’s transition to Envision, RWJF transferred responsibility for the network’s coordination from Gortmaker at Harvard to the Academy for Educational Development (AED), a nonprofit organization that was already supporting NCCOR, funded by Grant ID# 67082. In 2011, AED’s successor organization, FHI 360, took over the NCCOR/Envision support role, funded by Grant ID# 69419. (See the Appendix for grant details.)
“The capacity to estimate the energy gap has given us the yardstick we needed, says Orleans of RWJF, for equating changes on the food supply to the energy balance (‘calories in’) with changes on the physical activity side of the energy balance (‘calories out’).”

As Project Director Gortmaker sees it, the project has helped build an “emerging science that uses quantitative models (to provide) key insights into the dynamics of this epidemic, and enable researchers to combine evidence and to calculate the effect of behaviours, interventions, and policies” from the individual to the population level.30

As evidence of this new science’s real-world impact, Orleans notes that the team’s energy gap analysis contributed to the commitment in 2010 by 16 of the nation’s largest food and beverage companies to remove one trillion calories from their products by 2012 and 1.5 trillion by 2015 (against a 2007 baseline).

The companies, members of an industry coalition named the Healthy Weight Commitment Foundation, exceeded both goals, according to an evaluation of their effort funded by RWJF and conducted by researchers at the University of North Carolina at Chapel Hill led by Barry M. Popkin, PhD, MS.31

According to RWJF’s January 2014 announcement of the evaluation results, Popkin’s team found that as of 2012, the companies had removed 6.4 trillion calories—or 78 calories a day for each person in the United States—from the 2007 baseline level.

“Having a standard like this [the energy gap framework] allowed the food industry to step forward and make a goal that they thought would have impact on childhood obesity,” says Orleans.

Communications Results

- Gortmaker, Wang, and their associates published more than a dozen journal articles stemming from—or related to—the research supported by these RWJF grants. (See the Bibliography for citations.) They also made oral presentations on their work,

31 RWJF funded the evaluation with three grants to UNC-CH:
  - 67506 ($1,453,231, June 15, 2010 to June 14, 2011)
  - 68793 ($2,045,743, June 15, 2011 to June 30, 2012)
  - 70017 ($3,200,000, July 1, 2012 to June 30, 2014)
  - A fourth grant continues the evaluation: ID# 71837 ($1,021,000, July 1, 2014 to June 30, 2015)
including at the 2013 American Public Health Association annual meeting on their cost-effectiveness analysis of a sugar-sweetened beverage tax and other interventions.

- The four articles by COMNet/Envision modelers in the August 27, 2011, issue of the *Lancet* drew widespread attention in the popular media in the United States and abroad, including three *New York Times* articles by health columnist Jane Brody focusing of the causes of obesity and potential remedies.  

FHI 360 disseminated a press release promoting the articles and helped set up a press conference in London in conjunction with the issue’s publication. “Half of UK Men Could Be Obese by 2030” read the *Guardian* headline.

The *Lancet* articles also got attention in the scientific literature, drawing a total of 1,069 citations as of November 2013, the team reported to RWJF.

- Gortmaker used the research findings on sugar-sweetened beverages to help raise public awareness of their impact on health. In September 2011 he appeared with Boston Mayor Menino to kick off a city campaign to discourage consumption of sugary drinks.

Saying the average high school student drinks more than 300 calories of sugary beverages a day, Gortmaker cited evidence linking these drinks to obesity and other chronic health problems. “All of this is preventable,” he told the gathering.

**LESSONS LEARNED**

1. **Look outside the health field for solutions to the obesity epidemic.** The research team’s use of modeling techniques gave policymakers greater insight into the complex forces driving the obesity epidemic. This translated into important policy implications—among them the need for multiple efforts by various sectors, not only health, and for policies that impact the food and built environments. (Project Director/Gortmaker)

2. **Work through a formal collaborative to assure a wide reach, increased influence, and ongoing funding.** Working through NCCOR, a formal national collaborative of leading U.S. childhood obesity prevention research funders not only helped to assure the wide reach and influence of this research. It also engaged leading scientists at the CDC, NIH, USDA, and universities (through RWJF) in contributing to this effort and applying results in their broader research funding. And the collaborative effort created new ongoing funding streams for this pioneering work. (Orleans/RWJF Senior Scientist).

AFTERWARD

Supported by a $3.2 million grant from the JPB Foundation to Harvard, Gortmaker and colleagues expanded the cost-effectiveness research they began under the RWJF project. The four-year study (January 2012 through December 2015) is designed to assess the population-level health impact and cost-effectiveness of 40 childhood obesity interventions in the United States.

The 40 include an excise tax on sugar-sweetened beverages, elimination of tax deductibility as a business expense for TV advertising of non-nutritious food and beverages to children, and stepped-up physical activity requirements for school physical education classes. Wang at Columbia and modelers in Australia collaborated on the project.

Meanwhile, Envision continues as part of NCCOR, with RWJF supporting FHI 360 to coordinate the overall collaborative.33 Separately, RWJF funded FHI 360 to convene an international group of 8 to 12 systems science researchers to share their insights into the global childhood obesity problem.34 The meeting dates and other details were in the planning stage when this report was prepared.

At Columbia University, Wang expanded on her earlier energy gap work with the support of an RWJF grant to Columbia.35

A Promising Development

The 2010 Pediatric Nutrition Surveillance System (PedNSS)36 report found that overall obesity rates for children in the 2–4 age group were stable during 2003–09. Between 2009 and 2010, obesity prevalence declined from 14.7 percent to 14.4 percent, or 2 percent. While these data suggest overall progress in obesity prevention among low-income, preschool-aged children, the report’s authors recommend additional research using other data sets to confirm the results.37

33 Grant ID# 71060 ($547,708, August 1, 2013 to January 31, 2015)
34 Grant ID# 71473 ($238,526, December 15, 2013 to March 14, 2015)
35 Grant ID# 68162 ($329,990, November 1, 2010 to April 30, 2014)
36 PedNSS was a CDC surveillance system that monitored the nutritional status of low-income infants, children, and women in federally funded maternal and child health programs. It was discontinued at the end of 2012.
APPENDIX

Grant Details

Four Grants to Harvard School of Public Health

- Three of the four Harvard grants supported development and use of models to investigate the reasons and remedies for childhood obesity:
  - ID# 52194 ($102,388, November 15, 2004 to May 14, 2006)
  - ID# 57891 ($282,054, October 15, 2006 to June 14, 2009)
  - ID# 66284 ($710,564, August 1, 2009 to July 31, 2013)

- The fourth supported creation and coordination of the Childhood Obesity Modeling Network (COMNet):
  - ID# 61468 ($50,000, August 1, 2007 to December 14, 2009)

Two Grants to Organizations Supporting COMNet’s Transition to Envision

- ID# 69813 ($111,581, December 15, 2009 to June 30, 2011) to Academy for Education Development (AED)

- ID# 69419 ($80,389, July 1, 2011 to December 31, 2011) to FHI 360
BIBLIOGRAPHY

(Current as of date of the report; as provided by the grantee organization; not verified by RWJF; items not available from RWJF.)

Articles


**Lancet Series**

Members of the *COMNet/Envision* collaborative published a series of four articles on their obesity research in the August 27, 2011, issue of the journal *Lancet*, volume 378(9793):


This same *Lancet* issue also included a commentary on the obesity series:

- Dietz WH. “Reversing the Tide of Obesity,” 744–746, full text online.

**Website**

[www.nccor.org/envision](http://www.nccor.org/envision). A section of the National Collaborative on Childhood Obesity Research (NCCOR) website launched in 2011 to exhibit the work of statistical modelers supported by NCCOR’s Envision project. Washington: FHI 360.