PLOS Science Wednesday:My name is Dr. Sanjay Basu, I published two articles in PLOS Medicine modeling methods for preventing type 2 diabetes in India, including a hypothetical tax on sugar-sweetened be

PLOSScienceWednesday [1] and r/Science AMAs[1]

[1]Affiliation not available

April 17, 2023

Abstract

Hi Reddit, My name is Dr. Sanjay Basu, a physician and epidemiologist at Stanford University working on the prevention and treatment of type 2 diabetes and cardiovascular disease worldwide. I recently published two articles in PLOS Medicine that focus on diabetes prevention. In "The Health System and Population Health Implications of Large-Scale Diabetes Screening in India: A Microsimulation Model of Alternative Approaches" we found that large-scale community-based screenings in India are likely to produce a large number of false-positive results, particularly if using the currently available screening instruments. In "Averting Obesity and Type 2 Diabetes in India through Sugar-Sweetened Beverage Taxation: An Economic-Epidemiologic Modeling Study" we developed an economic-epidemiologic model that found introducing sustained taxation on sugar sweetened beverages could mitigate the increasing rate of obesity and type 2 diabetes in India. We found that given current consumption patterns, the relative effect of SSB taxes would be expected among both urban and rural populations in India. This is important in light of the increasing global prevalence of type 2 diabetes; the WHO estimates that in 2014 the global prevalence of diabetes (of all types) was already 9% among adults aged 18+ years. In recognition that a focus on prevention is critical to addressing climbing diabetes rates globally, PLOS Medicine has called for papers on diabetes prevention for a special issue. Publishing research on diabetes prevention is a top priority for PLOS Medicine, but to be considered for this special issue, all submissions are due on March 4 2016. To learn more about submitting your research, read the "Speaking of Medicine" post. I will be answering your questions at 1pm ET (10am PT, 6 pm UTC) – Ask Me Anything!

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REDDIT

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PLOSSCIENCEWEDNESDAY R/SCIENCE

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What's a safe amount of sugar, in grams, to eat daily if one is trying to never get type-2 diabetes?

Disyan

I don't see it as having been well defined. This is an interesting question in part because it gets to a fundamental scientific problem: how do we define safety in nutrition? At least two related issues are a problem: (1) because people don't eat just one nutrient, it is difficult to isolate the role of just one nutrient apart from the rest of the overall diet. hence people have been advocating for the study of overall dietary patterns and intra-nutrient relationships rather than one nutrient; (2) how do we identify 'unsafe'? we would expect that, except for truly immediately-toxic substances, the effects of nutrients would be diffuse and long-term. hence we have a problem of 'selection bias': that is, different individuals naturally end up eating different patterns of foods because of all sorts of cultural and socioeconomic reasons. we can't ethically keep people in laboratories over very long periods, so we follow people in the real-world over time, but their numerous other factors besides nutrition (stress, genetics, socioeconomics) end up confounding statistical associations between their nutrition and their

preventing type 2 diabetes in India, including a hypothetical tax on sugar-sweetened be, *The Winnower* 3:e145631.17402 , 2016 , DOI: 10.15200/winn.145631.17402

dietary outcomes. so even if we define the incidence of a particular disease as rendering an ingredient 'unsafe', it's hard to pull this apart from numerous other factors in life that resulted in that disease.

if you're interested in this topic, a few articles that might be of interest would include: http://www.ncbi.nlm.nih.gov/pubmed/11790957 http://jech.bmj.com/content/58/8/635.full

Hi Dr Basu!

I work for a UK health organisation so I have an interest in this topic, but unfortunately this isn't my area of specialism so I apologise if it's a rather uneducated question.

The UK are considering a tax on sugary drinks in a bid to combat obesity and other health issues that they can contribute to. Personally this is something that I am quite skeptical about, as I have always believed it to be more of an issue related to education about healthy and unhealthy food, such as eating things in moderation, rather than the availability of sugary goods. On first appearance, to me, it seems that a sugar tax will simply increase the cost of these goods, and those who would buy and consume them anyway will continue to do so. As a real world example, Mexico have tried a tax on sugary goods already with claims that it's not slowed down the rate of obesity and has only, on average, cut intake by 6 calories per person per day.

How much of a factor do you think that education about food (or lack thereof) plays in the obesity pandemic, and do you think that a sugar tax alone is enough to help curb health problems brought about by excessive sugar consumption such as obesity and diabetes?

EDIT: Just to clarify, I support a tax but I do not think it is enough on its own, and am quite skeptical about its effectiveness. In the UK at least, I feel that education at a school level does not cover enough about the health effects of excessive consumption of food, including sugary goods.

OldBoltonian

Thank you for your question. I think the short answer to your question is: I can't imagine any one intervention having sufficient impact to reduce such a large problem.

I also should point out that the data I have seen on the Mexico tax conflicts with the data you stated, or at least I have not seen any credible sources that support your claim. It is far too early to even have any data on obesity rates, since obesity takes years to develop and the tax was only recently passed. The most credible scientific data on the Mexico tax that I have seen is only the early stage publication in the BMJ (which says 6% reduction in purchases, not 6 calories per person): http://www.bmj.com/content/352/bmj.h6704

Hi Dr. Basu,

Many studies, but in particular:

- Adventist Health Study-2 - "Vegetarian diets were associated with a substantial and independent reduction in diabetes incidence."

and

- Influence of Nutritional Factors on Prevalence of Diabetes - "Prevalence of diabetes correlated well with serum cholesterol levels, both among and within populations."

Are both controlling for obesity and seem to indicate that the link between carbohydrate intake and diabetes is a bit tenuous, whilst cholesterol levels and diabetes seem much closer related.

How do you view these studies? Do you not feel that - at least parallel to advising less sugar - also a

lower-cholesterol- or even vegetarian diet should be advised?

puntloos

Thank you for your question. Unfortunately this is outside the domain of my expertise. I worry that the literature on nutrition is saturated with various different types of recommended diets, producing mass confusion as claims are made about how much evidence does or doesn't exist about the impact of a particular diet on future disease (full disclosure: I'm vegetarian myself, but for ethical rather than health reasons per se). I think there are several scientific problems that are inherent to the field, which make the study of specific diets difficult: (1) we expect their impact on chronic diseases to be long-term, but most randomized controlled trials of diets are shorter-term; (2) longitudinal cohort studies of diets suffer from tremendous self-selection, meaning that populations who eat a certain way also have a lot of other factors in their cultures and social and economic lives that differ and are hard to statistically control for; and (3) we rely a lot on serum biomarkers or other proximate indicators for outcomes, but these are often themselves not well-linked to actual 'hard' outcomes such as disease incidence, complications of disease, or mortality.

Is there any relationship between sugar substitutes and diabetes? I have heard that insulin is triggered in the mouth and that 0 calorie sweeteners can create false triggers. Is there any truth to this?

BishopRick

Thank you for your question. The associations between sugar substitutes and metabolic diseases is an area of really interesting ongoing studies, and I can't say that I've seen anything definitive but only early preliminary studies in this arena. A lot of attention has been focused on a few studies related to gut microbiota and whether or not artificial sweeteners including sugar substitutes may be related to alterations of the gut microbiota that could be related to metabolic abnormalities. I think if you're interested in this topic, some nice articles to read would include the following:
http://www.nature.com/news/sugar-substitutes-linked-to-obesity-1.15938
http://circ.ahajournals.org/content/126/4/509.full

Hi Dr Basu,

As an Indian who is at high risk of Type 2 diabetes (my entire family has it, including my brother who is in his 20s), I believe that awareness that diabetes is not just something that old people can get is vital, and an early change in lifestyle and eating habits is necessary.

My question is, what is currently being done to bring about awareness amongst youth in rural India (I would assume that awareness levels there would be much worse off than in most urban areas).

And if the government has any schemes to provide sufficient financial support, since I know that the medicines can rack up huge bills.

abhineetd

Thank you for your question. Both the earlier question by OldBoltonian and your question rightly pointed to the issue of education as central to diabetes prevention. There are actually quite a lot of educational programs, particularly towards youth, in India and elsewhere, regarding nutrition and physical activity awareness, though whether they are scientifically valid or 'sufficient' is a value judgement, and in my opinion the answer is widely varying by specific program.

I'd like to play devil's advocate for a moment and try to be scientifically critical about how much impact is achieved by education, awareness, and broader health promotion efforts. In my experience in the

public health field, it is very easy to say that a problem can be rectified by awareness and education, as no one would politically be opposed to these approaches, and if they are effective, there would be no need for more politically-difficult and imposing fiscal and regulatory interventions (e.g., taxes on unhealthy products).

But let's look for a moment at the quality of the data supporting education and health promotion. In my mind, it's almost a religious conviction that these approaches would be effective. Yet the data are surprisingly, and sadly, very poor. Perhaps the largest health promotion and education program was the North Karelia experiment in Finland. Despite claims that the nutrition, physical activity, tobacco education, and related advice and marketing approaches reduced heart disease mortality, actual careful epidemiological evidence suggests that larger societal forces reduced heart disease mortality in both North Karelia and in other areas where such programs were not in place: http://ije.oxfordjournals.org/cgi/content-nw/full/30/2/201/

In fact, the global cardiovascular disease mortality rates in high-income countries fell precipitously during the 1970's and onwards for two major reasons: tobacco taxes that were among the most effective means to reduce tobacco after educational efforts largely failed, and improvements in biomedical treatment of heart disease. Health promotion efforts like the Stanford Five-Cities Project continued to show neutral results/no benefit, sadly. And since then, efforts to demonstrate the benefits of health promotion or health education efforts have been sadly limited in showing sustained, long-term, hard-outcome benefits. Even the diabetes prevention program does not reveal actual prevention of diabetes; it delays diagnosis by only a few years at most, and doesn't affect the major causes of diabetes-related mortality: http://www.bmj.com/content/349/bmj.g4485

Hence, I think it's important not to be overconfidence or overstate the evidence regarding the efficacy of health education or health promotion, as it creates a false sense that broader fiscal or regulatory approaches are unnecessary.

Thanks for doing this AMA, I'm curious and wasn't able to find any published research on it; what is the public opinion in India on taxation of SSBs?

Anything along these lines:

Taxes on sugar-sweetened beverages: results from a 2011 national public opinion survey.

PHealthy

To my knowledge, public opinion surveys on this issue are lacking, so no, I don't know of any data in this area.

How high should a tax be to actually reduce consumption?

lucaxx85

Thank you for your question. I think this remains a very uncertain issue because there is often a threshold phenomenon that is not well-established: small increases in price are effectively "lost" because consumers will not notice them. large increases in price are potentially burdensome rather than merely discouraging from large-volume purchases. One way we can study this is through natural experiments in which we look at existing variations in prices that are varying in size, for example due to shifts in ingredient availability (such as recent spikes in raw ingredient commodities prices), in order to detect the thresholds. But the price-consumption relationship has to be defined more clearly in real populations. Another important caveats is the difference between an excise tax on production (something that shows up in the price on the shelf) and a sales tax (something that shows up at the

cash register), where the latter is less likely to be salient to the consumer.

I should clarify that not all fiscal approaches to shifting consumption are necessarily punitive, as with a tax. One approach we have been exploring is a so-called cap-and-trade policy. The idea is that, if we agree that excess added sugar consumption may be unhealthy, then merely taxing one product may be insufficient and ignore the continuous reformulation of products in the food environment. Additionally, such a tax is only mild in discouraging the underlying problem that food manufacturers have an incentive to flood the food marketplace with low cost foods containing high added sugars, whether solid foods or liquid foods. So is there a way to realign incentives between manufacturers and the health of consumers? This problem is analogous to that faced by climate change scientists: the energy produces have little incentive to invest in cleaner energy, as it's cheaper to burn coal, but is there a way to give them an incentive to do so? One market-based approach the climate scientists successfully implemented is a cap-and-trade policy: providing permits to, in our case, allow food manufacturers to "pollute" a certain amount of added sugar grams per 100grams of food products every year, by purchasing permits. Permits can be bought and sold among manufacturers, creating incentive to not have to buy as many, and the total number of permits in circulation is reduced over time, hence their price goes up to create a market-based mechanism to lower manufacturers' incentives to add more sugar to food products. The system effectively rewards reformulation. An early-stage model of the design was published here:
http://ajph.aphapublications.org/doi/abs/10.2105/AJPH.2014.302170

Dr Basu,

It's clear to me that efforts to target obesity and metabolic disease will have to involve population-based measures such as taxation of sugar-sweetened beverages, which are disproportionately cheap and damaging, and a key component of the obesogenic environment. To what extent do you encounter industry-sponsored lobbying against proposed taxes? I for one am sick of seeing "personal responsibility" parroted as an excuse to resist regulation.

pairyhenis

Thank you for your question. From a medical and public health perspective, we try to separate the issues of blame and personal responsibility from the issues of whether to introduce prevention and treatment measures for a population. There are a few reasons. First, as a clinician, nearly all patients I see with nearly all diseases could be stigmatized and blamed for their conditions. If you survive young adulthood, chances are that you will statistically end-up with a chronic disease--at the very least, hypertension--simply due to the natural course of aging. You could blame nearly any patient for their disease, but we make an ethical and political choice to dispense prevention and treatment measures because our choice is to not link blame with worthiness of receiving prevention and treatment. We could, as a society, choose to directly link some measure of blame-worthiness to dispensation of prevention and treatment services. That would mean that nearly no one other than the people with the rarest of pediatric genetic diseases, would receive any prevention or treatment services.

Certainly we experience a tremendous amount of industry pressure as academics. There are colleagues who receive industry funding and show up to conferences to interrupt presentations from those persons who have scientific findings that dispute industry sales efforts; we also regularly receive a large amount of hate mail, threats to ourselves and our families, and so on. Fiscal and regulatory measures are difficult because, as the argument below highlights, the perspective of many people is that public health measures are a controlling imposition, preventing individuals from deciding their health for themselves, and leading to social control. But if we accept that argument--that altering market forces are a method of social control--we would not criticize the minute public health taxes first, but examine the tremendously larger taxpayer-driven subsidizes that influence the food industry. So I see a bit of hypocrisy in criticizing public health measures that are small economically in terms of their

price and availability effects, without first looking at corporate subsidies that are much larger. A more logical standpoint would even be a fully laissez-faire approach of wanting neither subsidies nor taxes, but as Wendell Berry famously put it: “Rats and roaches live by competition under the laws of supply and demand; it is the privilege of human beings to live under the laws of justice and mercy.”

Dr.Basu, I have two questions for you.

1. How accurately do you think past price elasticity in demand reflects change in usage upon taxation? Doesn't past price fluctuation change usage because at some level people hope the price will come down again and they can wait until then. Meaning a permanent increase in price by taxation might cause a short decrease in consumption followed by a return to old rates of usage?

2. What factors do you think influence the effectiveness of this tax on a country by country basis? Meaning, if this can work in India, can it theoretically work in the USA as well?

Earthmate

These are excellent questions that get right to the heart of major challenges in modeling fiscal interventions in public health. The price elasticity of demand is difficult to estimate from classical methods such as almost-ideal demand systems (a microeconomic approach) that project from small variations to larger variations in price, and are a serious limitation of current methodology. The major long-term impacts of taxes on unhealthy products come from the tobacco taxation literature, where we have seen long-term sustained reductions in consumption following taxation. But better estimating price elasticity, and particularly cross-elasticity (meaning, substitution between types of products) is something we have increasingly tried to get at through natural experiments or quasi-experimental means, such as comparing model-based predictions to actual observations from, for example, the Mexico tax: http://www.bmj.com/content/349/bmj.g4485

There are a few ways that we can retrospectively answer the question of how effective a tax is, despite the near-impossibility of doing a randomized controlled trial of taxation. One approach would be the classical difference-in-differences method, in which we compare an affected population to a control population's trajectory of an outcome (let's say soda consumption) before and after the tax. A central dilemma is finding a control population that is sufficiently similar that we would believe that other factors are changing at the same rate in the control population as in the intervention population, except for the policy. That's quite hard. I've been interested in a newer method of synthetic control analysis that helps to pool data from many possible control populations in order to create a better-matched control population for a population that is affected by a policy, to produce a potentially less-biased scientific assessment of policy impact. Here's an example of that approach, applied to California's tobacco control program: http://www.hks.harvard.edu/fs/aabadie/ccsp.pdf

To your second question: the effectiveness of a tax is likely to vary substantially from country to country given the variations in consumption trends, what SSBs might be substituted for, and the stage of the epidemiological transition (how much the populations at highest risk are already affected) in the country. Nations like India are very early in the epidemiological transition, we think, and have not yet had the profound increase in SSB intake that we see in locations such as Mexico and the US. For a modeling-based assessment of an SSB tax in the US, see: http://content.healthaffairs.org/content/31/1/199.abstract

Thank you for doing the AMA, Dr. Sanjay. I would very much to hear your views on LCHF (i.e. ketogenic diet), and why this is still widely viewed as an unhealthy, unsustainable diet despite the massively growing clinical evidence to the contrary?

thebeesremain

I can't say that I'm informed enough about this topic, so would have to read more before I can responsibly address your question. Sorry.

Are there differences in the obesity/diabetic rates among nonveg hindus vs nonveg muslims? I have been reading about the gut microbiome health (F/B ratio) theory of obesity, and have come to believe that periodic fasting (like with Ramadan) might be a major factor in alleviating obesity and diabetes. If Muslims who fast for Ramadan had lower rates, that would lend some credence to that theory (though its hardly an isolated factor).

Also, what are your thoughts on the gut microbiome health theory of obesity, and your thoughts on high fat low carb diets?

kuj0317

See above for my thoughts about why its challenging to conclude very much about any one specific diet. I think the theories about how microbiomes are related to our health are at an extraordinarily early stage of investigation, and I would view them at this point with great skepticism. It will be quite a few years until even the first substantial data that are reproducible and linked to hard outcomes is available. In the meantime, I think it's worth being patient and not drawing too many conclusions too early.