

Should you eat and damage your health?

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Abstract

Genetically modified crops have been a source of controversy for at least three decades. However, concerns of contamination of the natural habitat by these crops to produce mutant “Triffid” like strains have not materialised. The modifications were introduced to make the crops tolerant to weed killing herbicides and in the last 20 years it is becoming apparent that these herbicides containing glyphosate are the real cause for concern. Glyphosate is now classed by the International Agency for Research on Cancer as “probably carcinogenic in humans” but the last 20 years have seen the advent of food costs rising less than inflation and greater productivity for farmers. For most people the cost of organic (grown without herbicides) crops makes them totally impracticable and only the wealthy in Western nations can afford such food over a long-term basis. We all take risks in everyday life and eating is just one of them; the issue then, is how much of a risk are we taking?

Introduction

The debate concerning genetically modified crops has been raging for the last 25 years. Mostly, the protagonists are large industrial chemical conglomerates like Monsanto who have spent vast resources on research into modified crop strains resistant to herbicides. The antagonists have unfortunately been somewhat misguided and taken public awareness away from the true problem. Genetically modified (GM) crops are still a small proportion of the world's supply of food and the GM crops in themselves in repeated trials have proved to be no more harmful than conventional crops grown with herbicides and fertilisers. There is some evidence that the GM crops retain some of the harmful elements of the herbicides but now so many crops are grown using herbicides that trials comparing toxicity of GM crops with non-GM crops are effectively comparing like with like.

The true problem is herbicides. The need to weed before sowing arable land and the increasing cost of farm labour in America in the 1940s, led to various simple herbicides being investigated¹. Crop loss due to weeds is estimated at anything between 50 and 90%. The first and most successful, 2,4-D (2,4-dichlorophenoxyacetic acid), was subsequently succeeded by the more non-selective glyphosate. Further research by Monsanto in the 1970s then produced glyphosate ((*N*-(phosphonomethyl)glycine)) based herbicides, usually including other adjuvants (such as surfactants as wetting agents), which themselves can be toxic. In the last 20 years the most used product is from Monsanto with trade mark name Roundup based on glyphosate. It is used before sowing as a weed-

¹ LEONARD P. GIANESSI, SUJATHA SANKULA, THE VALUE OF HERBICIDES IN U.S. CROP PRODUCTION, APRIL 2003, National Center for Food and Agricultural Policy <http://www.ncfap.org/documents/FullText.pdf>

killer and after harvesting as a desiccant. Being soluble, glyphosate finds its way into water supplies, although according to many regulatory bodies, is below safe limits. Unfortunately such limits have been set by bodies who have been influenced by vested interests who have ignored more recent findings of the toxic effects of very low dosage.

The USA has the most usage of herbicides and estimates put the benefits to be some 20% more produce utilising a fraction of the agricultural labour force. It has also enabled the land to be used continuously for crop growth rather than having a fallow year when the ground is tilled to destroy the weeds: this is one reason why organic crops cost more. Concern has been rising for many years about the effects of glyphosate on both animals and humans. As a herbicide it is designed to kill plants and it is perhaps not surprising that animals are likely to remain affected. The chelating property of glyphosate has meant that metal trace elements are removed from crops reducing many animals' ability to produce complex enzymes essential for healthy life. With residual glyphosate in the plants then finding its way into the gut of animals, this effect is then further exacerbated resulting potentially in many human diseases of the gut and brain. There is considerable correlation between US farm workers and people living near farms using herbicides, of higher incidence of such diseases over the last 20 years. The causes of many of these diseases are complex and even though there is a geographical correlation there could be other factors in play. Nevertheless, findings are significant and cause for concern. In March 2015, the International Agency for Research on Cancer classified glyphosate as "probably carcinogenic in humans".

The original antagonists of GM crops were misguided The bigger problem is not the genetic modification but the herbicides they are designed to tolerate.

The protagonists and much of the population have benefited from the extensive use of herbicide in both the reduced price of much of our food and the increased production, not forgetting profit for the protagonists and tax revenue for Governments. The growing interest in organic crops only using natural fertilisers and no herbicides is laudable. But organic food is expensive as there are very few organic farms in the USA and the price of the produce reflects the extra labour involved in bringing the crop to market. Across a broad spectrum of cereals, vegetables and fruit, the extra cost can be as much as 200% more but on average is around 40%. Interestingly, organic rice is the same price, probably because it is grown in water and the herbicides is too diluted.

The question is, if you eat even healthily, that is with little processed food, are you risking your health? For most people the cost of organic crops makes them totally impracticable and only the wealthy in Western nations can afford such food over a long-term basis. We all take risks in everyday life and eating is just one of them, the issue then is how much of a risk are we taking?

The Benefits

In the USA, within 2 years of the introduction of 2,4-D in 1962, the acreages in the Northwest that previously had been heavily infested with bindweed were brought into wheat production¹. Moreover, by 2001 it was estimated that without the use of herbicides, yields would be 21% lower over an average of 40 crops. In addition food prices have risen less than inflation over the last 10 years, partly due to increased mechanisation but certainly in the USA, due to the use of herbicides to control weeds. By 2014 US farmers² in their quest for lower production costs had converted over 90% of planted acreage for corn, soybeans and cotton to GM crops.

Active ingredients applied to US cropland in 2007 cost roughly \$7.9 billion of which half was spent on herbicides³. Value-added tax would have provided nearly \$1 billion to the US tax income, apart from the profit made by the chemical companies supplying the herbicides and the tax paid by them to the government.

In the UK the growth in crop yields since the Second World War has been more gradual reflecting the effect of government subsidies and greater mechanisation. By 2013, 37% of arable land was farmed organically⁴ and thus the impact of herbicides was less significant. In fact the use of herbicides has been in slight decline since 2010⁵.

The Risks

Assessing the risks of eating food produced by conventional means, implying the liberal use of glyphosate herbicide, is not easy. In the nuclear industry the effects of radiation leaks from fissile material have been extensively studied and the correlation of exposure to radiation with cancer related diseases is both significant and well documented with the consequential decrease in life expectancy⁶. The J-value assessment provides a ratio of what is spent, to the maximum of what could be spent, to maintain life expectancy against this risk. It is thus possible to put a cost on measures for the prevention of radiation related accidents and the benefit in terms of increased life expectancy of the individuals who might have been exposed.

The correlation between birth defects in areas growing GM crops and using glyphosate

² **Jorge Fernandez-Cornejo, Seth James Wechsler, Michael Livingston, and Lorraine Mitchell**, Genetically Engineered Crops in the United States, Economic Research Report No. (ERR-162) 60 pp, February 2014

³ United States Department of Agriculture, Economics Research Unit

<http://www.ers.usda.gov/topics/farm-practices-management/chemical-inputs/pesticide-use-markets.aspx>

⁴ http://www.ukagriculture.com/crops/spraying_of_pesticides.cfm

⁵ Pesticides in the UK, The 2011 report on the impacts and sustainable use of pesticides A report of the Pesticides Forum

<http://www.pesticides.gov.uk/Resources/CRD/Migrated-Resources/Documents/P/Pesticides-Forum-AR-2011-revSep12.pdf>

⁶ P. J. THOMAS, D. W. STUPPLES and M. A. ALGHAFAR, CONSENSUS ON HEALTH AND SAFETY EXPENDITURE: Part 1: Development of the J-Value Trans IChemE, Part B, September 2006 doi: <http://dx.doi.org/10.1205/psep05005> THE EXTENT OF REGULATORY Process Safety and Environmental Protection, 84(B5): 329–336

herbicide in Argentina is significant; possibly as much as 23% increase in birth defects over the 20 years since extensive GM crop farming has been undertaken⁷. Much of the land used in Argentina for crop farming was rainforest and so correlations between disease in the local community and industrial farming can be assessed, with some confidence, as due to the use of herbicides. With good healthcare many birth defects now can be managed, albeit at some cost, and often life expectancy of the individual will be similar to the average. Separating the effects of healthcare from diseases where life expectancy might otherwise have been reduced is now almost impossible in advanced economies.

Simplistically, one might expect healthy eating and life expectancy to be correlated. This may be true but raises another question concerning healthy eating which in many cases maybe just due to education and awareness. Intuitively, one might think that income has an impact because high income groups would be expected to consume better quality food. Assuming that there is nothing fundamentally toxic about food, there ought to be a correlation between high income groups (usually associated with better education and healthier food intake, such as less processed food) and longer life. Unfortunately, such a correlation is in dispute. Preston in 1975⁸ showed that once countries reach a threshold GDP per capita there is no difference in life expectancy between rich and poorer nations. More locally this may be disputed as a recent study by London Health Observatory showed that life expectancy may be reduced by 7 years between the richest to the poorest London boroughs⁹.

Using the Office of National statistics data for the United Kingdom exemplifies the problem. Data for the period 1997 to 2012 is available showing life expectancy for men and women¹⁰ in nine regions and the disposable income per head¹¹ from representative areas within those nine regions. Plotting the two together gives life expectancy versus disposable income in figures 1 and 2. Disposable annual income is that after tax while the nine regions are the North East, North West, Yorkshire, East Midlands, West Midlands, London, East, South East and South West. The plots show that since the credit crisis in 2007 /2008 that the income divide between the North and South has increased, as has life expectancy. However, life expectancy is now the same for a wide range of incomes and only below a threshold is there a reduction in life expectancy, and this

⁷ Medardo Ávila-Vázquez, Devastating Impacts of Glyphosate Use with GMO Seeds in Argentina, ISIS Report 18/02/15; http://www.i-sis.org.uk/Devastating_Impacts_of_Glyphosate_Argentina.php

⁸ The Preston curve indicates that individuals born in richer countries, on average, can expect to live longer than those born in poor countries. However, the link between income and life expectancy flattens out. This means that at low levels of per capita income, further increases in income are associated with large gains in life expectancy, but at high levels of income, increased income has little associated change in life expectancy.

⁹ Public Health England

http://www.lho.org.uk/LHO_Topics/National_Lead_Areas/HealthInequalitiesOverview.aspx

¹⁰ Office for National Statistics, Life expectancy at birth and at age 65 by local areas in the United Kingdom, 2006-08 to 2010-12

<http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-354758>

¹¹ Office for National Statistics, Regional Economic Analysis, GDHI for Local Enterprise Partnerships, 1997-2013

<http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-414361>

corresponds to the North East and North West regions.

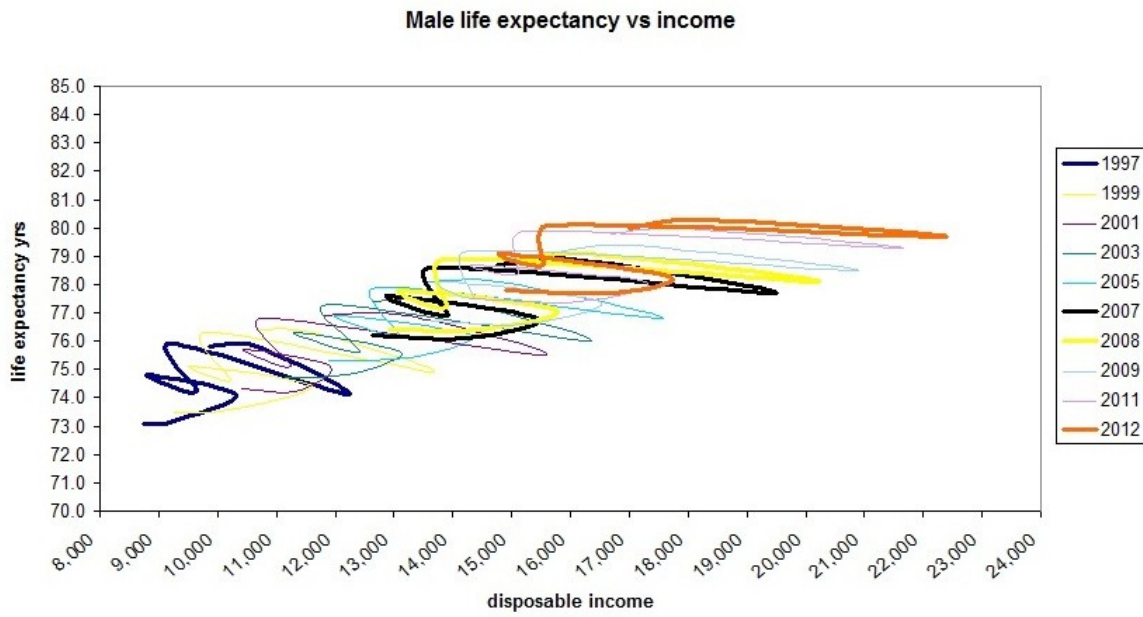


Figure 1 Male life expectancy vs disposable income £, UK

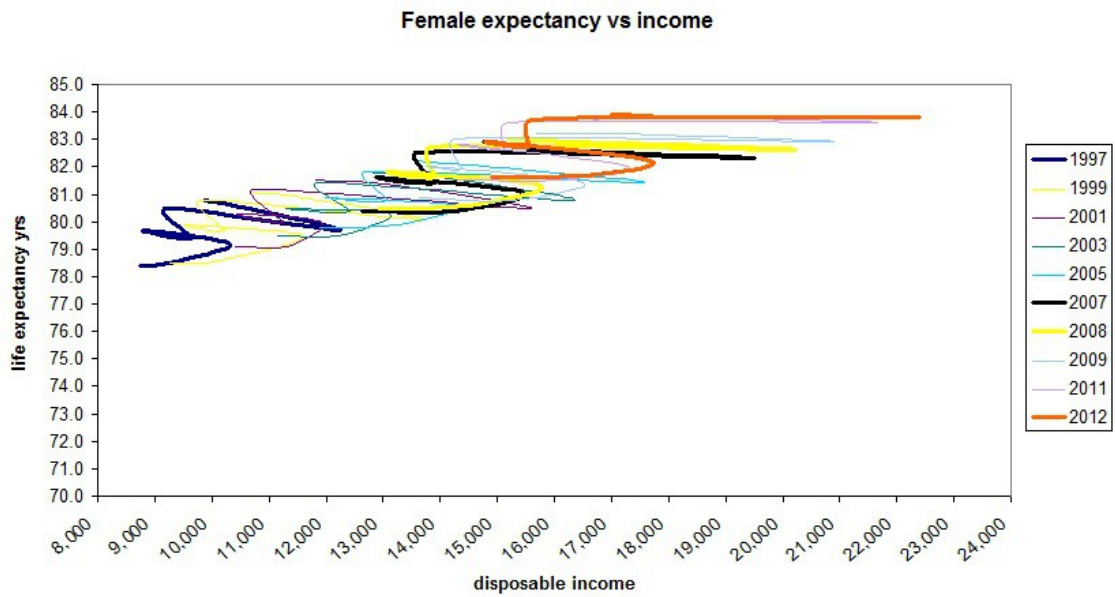


Figure 2 Female life expectancy vs disposable income £, UK

Looking at expenditure on food in more detail, in figure 3, shows the difference between

average spend on food and that of the lowest income groups compared to that of a perceived healthy diet¹². This tends to show that the lower income groups spend less on food and in particular from figure 4, shows that this money is spent to the detriment of foods like cereal, vegetables and fruit; in effect reducing their exposure to food grown with herbicide.

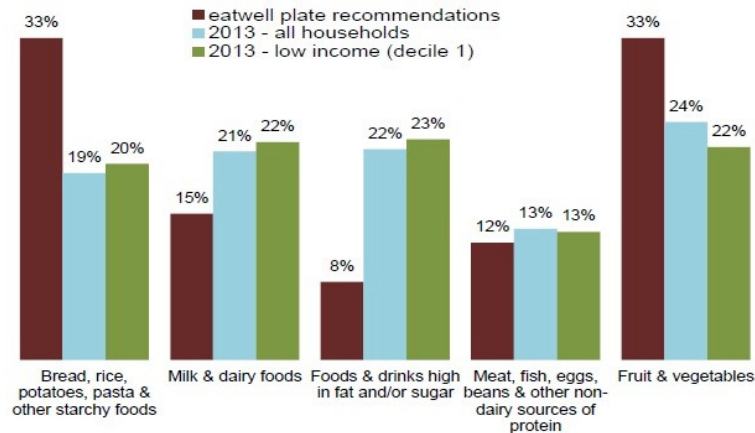


Figure 3 3year average food spend by product in UK

	Lowest region	Lowest value	Highest region	Highest value	Ratio of lowest to highest
Household purchases					
<i>grams per person per week unless otherwise stated</i>					
Milk and cream	London	1677 (ml)	East Midlands	2101 (ml)	1.3
Cheese	North East	97	South West	132	1.4
Carcase meat	Yorkshire & the Humber	180	East	212	1.2
Non-carcase meat and meat products	London	683	North East	818	1.2
Fish	North West	135	London	162	1.2
Eggs	North East	2 (no.)	East	2 (no.)	1.3
Fats and oils	North East	156	East Midlands	191	1.2
Sugar and preserves	North East	106	East Midlands	147	1.4
Potatoes	London	552	East Midlands	784	1.4
Vegetables excluding potatoes	North East	981	South East	1209	1.2
Fruit	North East	875	South East	1270	1.5
Total cereals	South East	1482	East Midlands	1639	1.1
Beverages	London	44	South West	62	1.4
Soft drinks ^(a)	London	1304 (ml)	East	1779 (ml)	1.4
Alcoholic drinks	London	472 (ml)	North East	839 (ml)	1.8
Confectionery	London	92	North East	144	1.6

Figure 4 3year average food consumption by region in UK

¹² Family Food 2013, Published by the Department for Environment, Food and Rural Affairs https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/385694/familyfood-2013report-11dec14.pdf

Overall, looking at these figures it seems to confirm Preston's hypothesis that above a certain level of income, life expectancy is not correlated, but below this there are indications of a poorer diet affecting life expectancy. The question remains, is this correlation representative of a causal effect or, at most, merely indication of a catalyst. One might assume that because of the increased expenditure on food by high income groups that some of the money was spent on organic produce and that this then also perhaps contributes to a maximum of life expectancy. The problem is that as human beings we represent a very complex system and it is extremely difficult to isolate one cause which explains an effect on life expectancy. Evidence from small in-vivo studies of the effects of glyphosate sprayed crops on human health might be quite compelling but the studies are of small samples while on a larger scale there is little evidence of correlation let alone cause of disease due to eating such food.

Without data on a large scale of a comparison between humans eating organic and conventional food, it is impossible to conclude from the UK data that by spending more money on organic food they would expect to live longer.

Data from the USA shows that Americans have a shorter life expectancy than many of the other Western economies¹³; some three years less for men and women compared to the UK. Like the UK, there are life expectancy reductions in certain areas where disposable income is lower than the average. Possible reasons for US life expectation may be the increase in sedentary activity and the fact that Americans spend a lot of time in cars driving long distances and as a consequence are more likely to die in automobile accidents. Other factors include less government spending on social problems such as housing, poverty and childcare.

Recent statistical studies comparing glyphosate related diseases and their incidence per capita over the last 20 years since the extensive use of herbicides has become widespread show significant correlation, especially in agricultural areas of the US¹⁴. However, this is more a time correlation and is not necessarily indicative of a cause. The cause could be the factors perceived to explain the reduction in life expectancy, although in the case of America, the lack of public health care until recently might be expected to reduce life expectancy for those in poorer communities affected by herbicide related diseases.

Conclusions

Unfortunately, the data is unable to support a quantitative risk analysis using a J-value approach. It is not possible to form a measure of how much more should be spent by

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Why Do Americans Have Shorter Life Expectancy and Worse Health Than Do People in Other High-Income Countries? Annual Review of Public Health, Vol. 35: 307-325 (Volume publication date March 2014). DOI: 10.1146/annurev-publhealth-032013-182411 <http://www.annualreviews.org/doi/abs/10.1146/annurev-publhealth-032013-182411?journalCode=publhealth>

¹⁴ S. Seneff and A. Samsel, Glyphosate, Pathways to Modern Diseases IV: Cancer and Related Pathologies, JBPC Vol 15 -3;121-159; , Sept 2015

government on promoting organic food production to preserve life expectancy any more than it is possible to make an assessment of how much more individuals should spend on the annual food bill to avoid eating crops grown with herbicides.

So where does this leave the question of whether we risk our health by eating. Evidence from America and Argentina that health could be at risk from eating such crops is significant but the diseases associated with exposure to glyphosate have been identified for a long time and their causes are not solely due to herbicides¹⁵. The risk to Europeans is probably low, simply because of the lesser uptake in the use of herbicides and GM crops, on the other hand farmers might be slightly concerned as they are more exposed.

In the UK typical food spending is about 15% of disposable income so if organic food costs some 40% more, then the question arises as to whether people would be prepared to spend 20% of disposable income on food, or for an average disposable income, some £1000 more per year?

The other alternative is that the government spends tax money subsidising organic farming or more restrictive regulation of herbicides but the evidence for such a measure is not supported nationally as a duty of care to maintain life expectancy.

So as an individual what can one do? Support more long term studies by independent bodies on the effects of glyphosate (and its adjuvants) in the main brand herbicides on animals in order to regulate its use safely, and possibly refrain from American imports.

¹⁵ Mae-Wan Ho, Glyphosate Carcinogen or Probable Carcinogen?, JBPC