

The China Study: A Re-Analysis of the Data.

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ABSTRACT

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The China Study is a popular book on the topic of plant-based nutrition published in 2006 by author T Colin Campbell. It uses data from the China-Oxford-Cornell study to draw conclusions about animal-based diets. This paper is an attempt to re-analyze the data in order to verify some of the claims made in the book. Upon subjecting the China data to Pearson correlation, I found that several of the main nutrition points in Campbell's book were misleading, while some were accurate.

Keywords: Nutrition, Plant-based diet, China Study.

I. Introduction:

The China Study is a book written by T Colin Campbell in 2004. Campbell is a professor of nutritional biochemistry at Cornell University, and has published over 300 papers on the topic of nutrition. He specializes in the effects of nutrition on long-term health. He was also one of the lead scientists in the China-Oxford-Cornell study, a 20-year nutrition study done in China that analyzed nutrition information and mortality rates over the course of 20 years. The study analyzed nutrition intake surveys and blood work, and cross-referenced them with mortality and chronic disease rates for 100 subjects in each of 65 different counties in China. His subsequent book, titled "the China Study," published in 2004 discusses the results of that study and the implications of over-consumption of animal protein. The purpose of my research is to determine whether the book honestly represents the study data, or whether it misinforms the public.

There are risks associated with the overconsumption of any food, but there are several that are particular to overconsumption of animal products. Increased LDL cholesterol levels can lead to atherosclerosis, which can cause myocardial infarction, stroke, and peripheral vascular disease¹. Increased saturated fat intake from animal sources has also been associated with increased risk of cardiovascular disease². Colon cancer has been linked with decreased fiber intake and excessive consumption of animal protein³. Some people have linked hormonal issues with increased intake of dairy and some other animal products, claiming that agricultural hormones may have carried over into the animal products.

The China Study discusses several major diseases of our time and links them all to overconsumption of animal protein, and not enough plant intake. In the China Study book, the author discusses obesity (page 135), heart disease (111), breast cancer (158), colon cancer(168), prostate cancer (177), autoimmune diseases (183), osteoporosis (204), kidney stones (211), macular

degeneration (214), and Alzheimer's disease (217). He correlates all of these diseases to animal protein intake, through different physiologic mechanisms throughout the book. He then goes on to discuss a concept that he calls "8 principles of health," which is basically a discussion of his nutritional recommendations for everyone to avoid these chronic diseases. The China Study is one of the best selling nutrition books of the past decade, and with its subsequent documentary "Forks over Knives," it has reached a wide audience. My concern is whether the book correctly represents the data, or whether it misleads its audience.

The China-Oxford-Cornell study focused on mortality in the Chinese communities, and it attempts to explain that mortality through data on nutritional intake. The China Study discusses many different diseases and attempts to correlate them to animal protein intake. These diseases include Heart Disease, Obesity, autoimmune diseases, osteoporosis, kidney stones, macular degeneration, Alzheimer's disease, and Cancers of the Breast, Colon, and Prostate. Here we inherently run into a problem, since the China-Oxford-Cornell study only gives data for mortality, it does not include data on kidney stones, obesity, macular degeneration, Alzheimer's disease, osteoporosis, prostate cancer or autoimmune diseases. These are major facets of Campbell's book, and he largely takes data from other third-party sources to support his claims that animal protein intake is responsible for these issues. In fact, the only disease statistics that Campbell discusses that are actually present in the China-Oxford-Cornell study are heart disease, breast cancer, and colon cancer. These are the disease statistics that we will analyze here to determine whether they are represented correctly in the China Study book.

II. Discussion of the Data

While analyzing the data, a few discrepancies quickly present themselves. First we have an issue regarding dairy intake. It appears that very few counties in China reported actually having consuming dairy (13 out of 68 counties.) On closer analysis we see that of those 13 counties, 10 have a very low

dairy intake, between 0.5 and 9 grams of dairy per day. The remaining 3 counties, WA, YA, and WB have intake levels of 94.2, 135.2, and 292.2 grams/day, respectively. When you consider the fact that a single cup of dairy consists of 244 grams, and the highest county in terms of dairy has an intake of 292.2 grams, this can hardly be considered an excessive intake. Given that the vast majority of counties participating in the study have zero dairy intake, these three counties skew the data to a degree that I would argue that the data on dairy is largely unusable. If the data from these 3 counties was dropped, the dairy consumption data would look like a flat line hovering just above 0. Yet Colin Campbell uses the data on dairy in his book to backup his argument about autoimmune disorders, claiming that they are caused by excessive dairy intake. I would deem that the data on dairy is unusable, and that this argument regarding the link between dairy and autoimmune disease be disregarded.

The second discrepancy that we see upon analyzing the data is that there is a 10 year time gap between the mortality data and the dietary data. The mortality data was procured in 1973-1975, while the nutritional intake data was procured in 1983-1984. Is this enough of a time gap to throw off the data? This is a speculative question, given that it would probably take more than a decade to completely change the diet of an entire population, but it is possible to have large population growth and/or migration trends during such a short period. This is a question that is not easily answerable, but it is my opinion that one cannot establish a causal link when looking at data from two different decades.

One of the main claims that Campbell makes in the China Study is that several major cancers are directly related to intake of animal-based foods. He claims that breast cancer is related to the intake of animal fat (page 160), that liver cancer development is directly related to animal protein intake (page 63), and that colon cancer is due to a number of factors including intake of animal protein, fiber, and cholesterol (page 169). But are these claims supported by the data?

The first claim is that breast cancer is related to the intake of animal fat, cholesterol, and possibly dairy due to the alleged hormone content of bovine dairy and the effect that it has on the female hormones. Neither of these claims are supported by the data, however. As previously discussed, the data on dairy intake is virtually unusable. This renders this part of the claim unsupported. When we look at the argument that breast cancer can be correlated to animal fat intake, we find that this claim is also unsupported by the data. When comparing the data of animal fat intake to breast cancer death rates in women 35-69 years of age in the China-Oxford-Cornell study, we find that the comparison line is flat, indicating no correlation between the two variables (Figure 1.) We also do not find a significant correlation between breast cancer deaths and cholesterol intake (P value is 0.0724,) indicating that this part of his claim is not supported by the China data (Figure 2.)

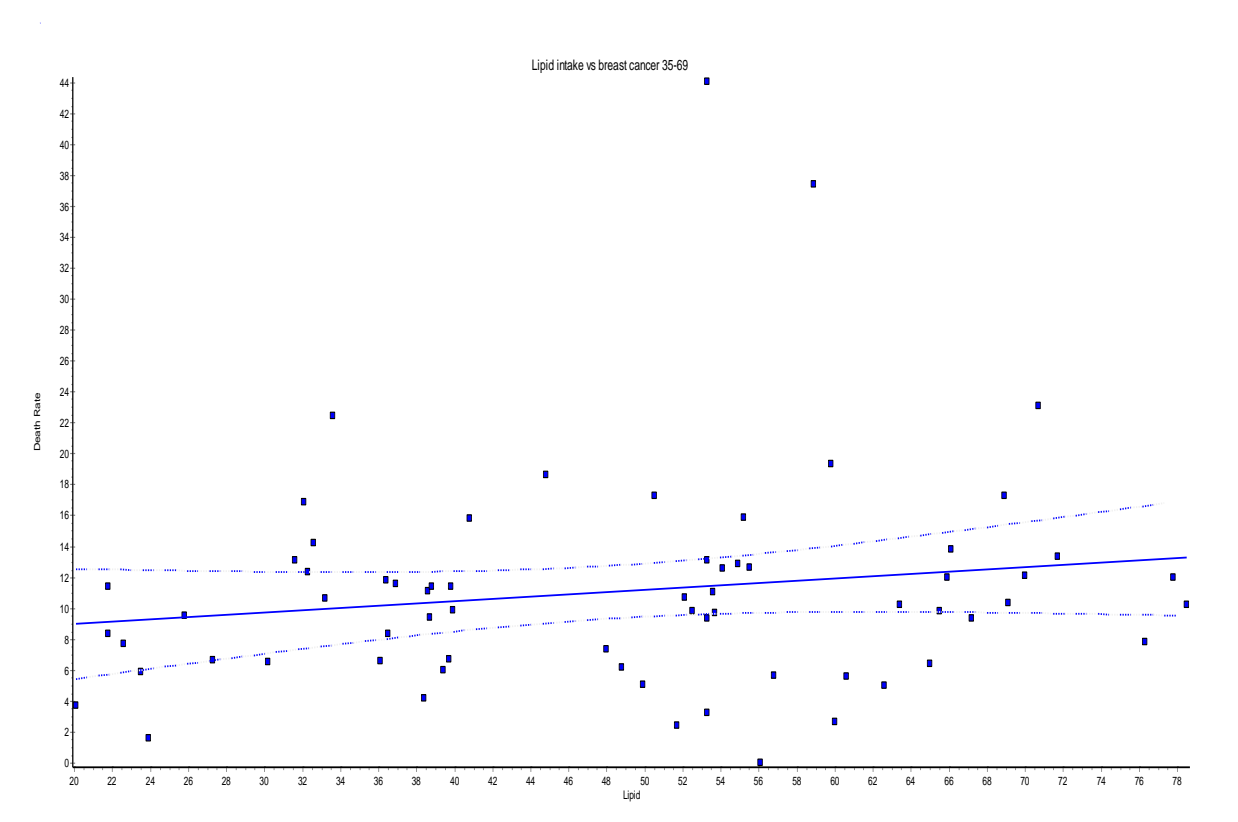


Figure 1. Correlation Plot for comparing breast cancer death rates in the 35-69 year age range with lipid intake. The P value is 0.1905, R = 0.02622.

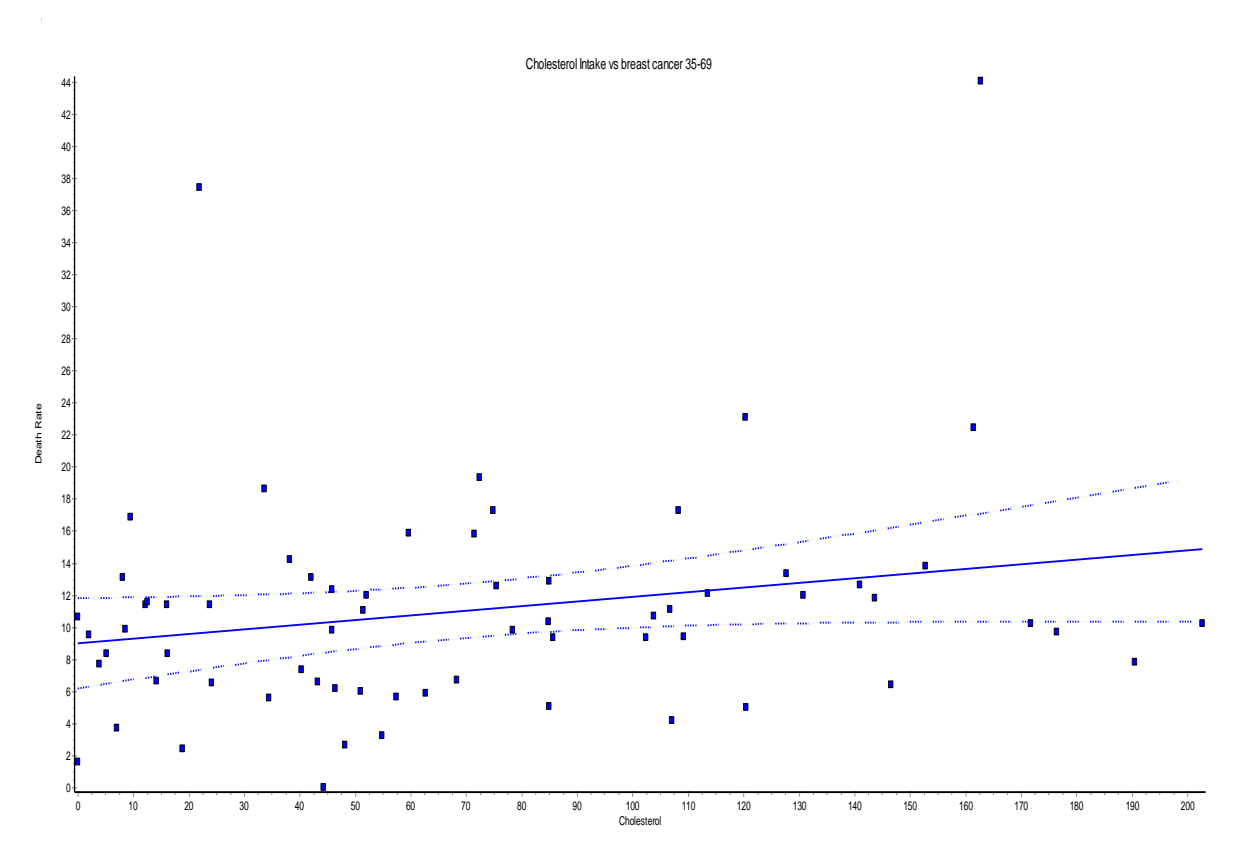


Figure 2 Correlation Plot for comparing death rates from breast cancer in the 35-69 year age range with Cholesterol Intake. The P value is 0.0724, R = 0.04882. Considered not significant.

Next Campbell makes the claim that colorectal cancers are due to a combination of decreased intake of fiber and increased intake of animal protein (page 169). The increased intake of animal protein will come hand-in-hand with increases in lipids and cholesterol. The study includes data on dietary intake of animal protein, plant protein, cholesterol intake, and colorectal cancer death rates in the age group of 35-69 years old. The data did not support a direct correlation between increases in animal protein and increases in colorectal cancers. When we analyze the data on plant intake, we also do not see any correlation between plant protein intake and colorectal cancer deaths. There is a slight correlation between colorectal cancer deaths and lipid intake (p value = 0.0272, R = 0.07287.) This does support a correlation between colorectal cancer and lipid intake (Figure 3.) When we look for a

correlation between colorectal cancer deaths and cholesterol intake, however, we do not find one that is supported by the data (Figure 4.) The P value for a correlation between colorectal cancer death and cholesterol intake is 0.1261, with an R value of 0.03562. This indicates a lack of correlation.

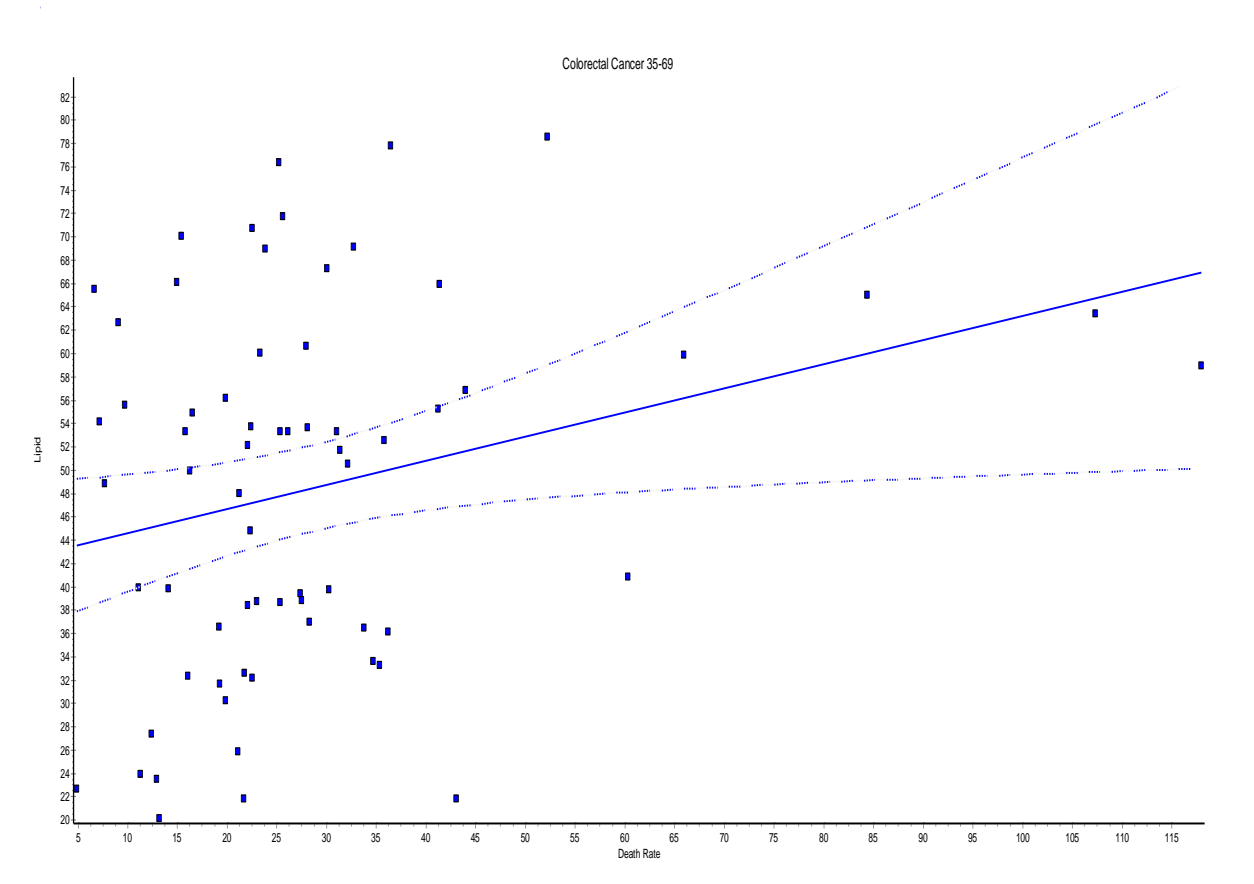


Figure 3. Correlation Plot for Colorectal Cancer deaths in the 35-69 year age range when compared to Lipid intake. The P value is 0.0272, R = 0.07287.

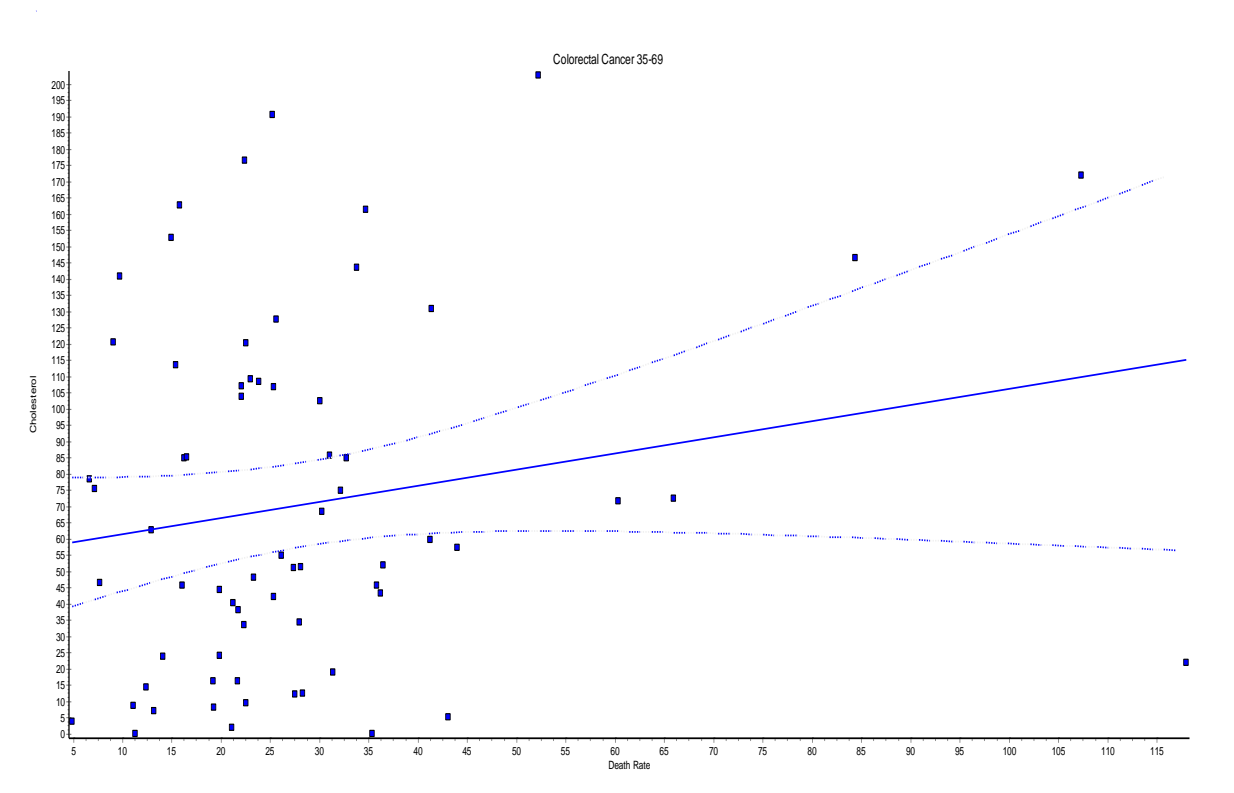


Figure 4. Correlation Plot for colorectal cancer deaths in the 35-69 year age range when compared with cholesterol intake. P value 0.1261, R value of 0.03562.

Campbell discusses that there are a number of factors that contribute to colorectal cancer rates (page 169), and indeed this much is true. His claims, however, that animal protein intake and cholesterol intake are directly attributable to colorectal cancer are not supported by the data of the study. The study does not include data on fiber intake, however, it is well-documented that fiber intake is a preventative against colon cancer and polyps⁴⁵. This does support this portion of Campbell's claim.

Campbell makes the connection that liver cancer is related to animal protein intake, hepatitis B infection, and blood cholesterol (page 63). Since Hepatitis B information is not available in the study data, we will have to look at the other factors involved here. When we look at the rates of liver Cancer vs protein intake we see a p value of 0.1550, considered not significant, indicating a lack of correlation between overall protein intake and liver cancer deaths. When analyzed versus data on carbohydrate

intake, we see an inverse correlation with a p value of 0.011, this is a decent correlation, indicating that plant protein may be protective against liver cancer deaths. Next we analyze the percent of diet that is based on animal products compared to liver cancer deaths in the 35-69 year old age range, we see a positive correlation with a p value of 0.010, this is considered to be significant. Upon analyzing cholesterol intake and its relationship to liver cancer in the 35-69 year age range, we see a strong positive correlation with a p value of 0.0044 (Figure 5.) This indicates a strong relationship between cholesterol intake and liver cancer. Since cholesterol is only coming from animal-based sources, we can see that there is a correlation between liver cancer and the percent of the diet that is based on animal products. These two correlations support Campbell's theory about animal protein intake being responsible for liver cancer.

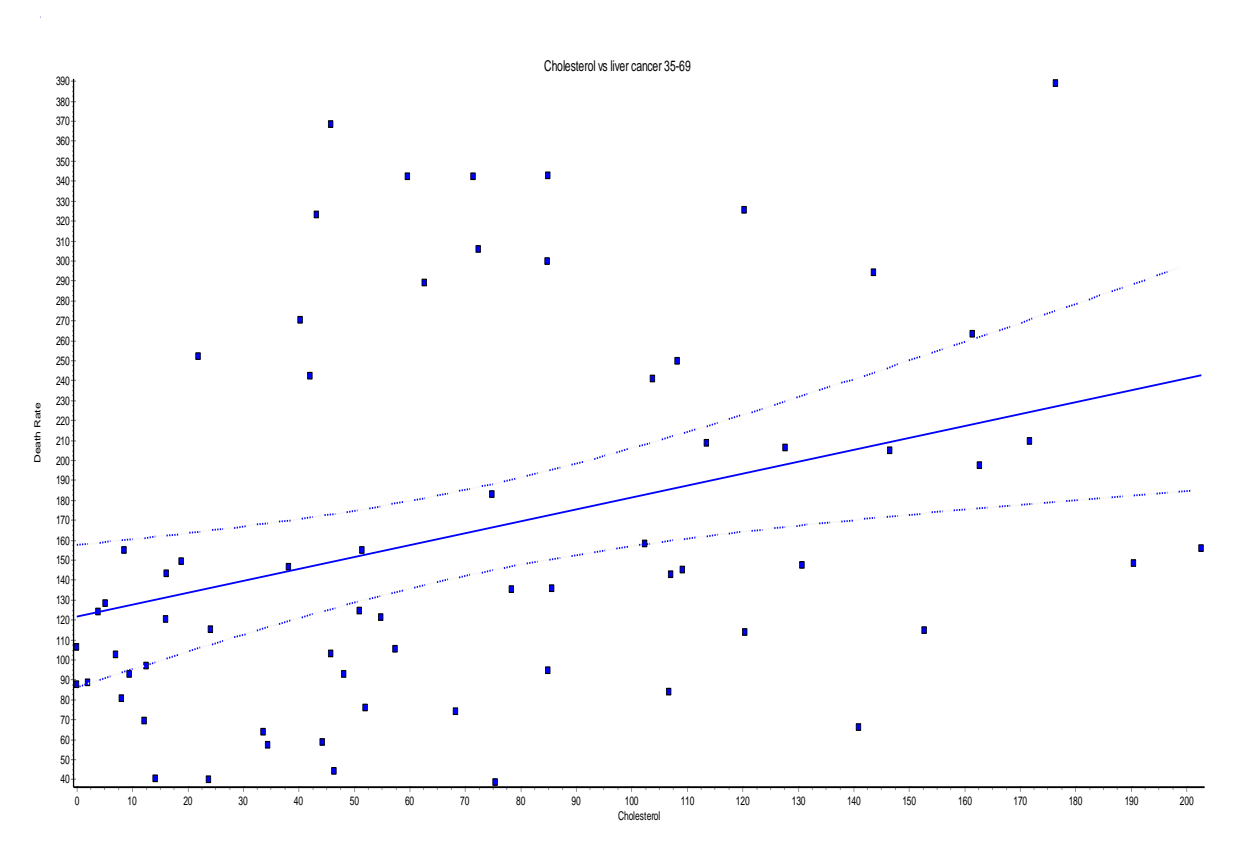


Figure 5. Correlation Plot for Liver cancer deaths in the 35-69 year age range, when compared to cholesterol intake we see a P value of 0.0044, R = 0.1181. Considered very significant.

When we take a look at the data from the China-Oxford-Cornell study regarding overall neoplasm deaths in the 35-69 year old age range, we see that there is hardly any correlation at all between the death rate and dietary intake from animal sources. The correlation between overall protein intake and neoplasm deaths in this age range is very low (p value = 0.3522.) The correlation between the percent of foods from animal sources and neoplasm deaths is also low (P value = 0.9117.) The correlation between the percent intake of dairy and neoplasm deaths is also low, despite the previously discussed fact that the dairy data is virtually unusable (P value = 0.6024.) And the correlation between lipid intake and neoplasm deaths in this age range is also low (P value = 0.3093.) So we can see from this data that the instances of neoplasm deaths in the China-Oxford-Cornell study data cannot be accurately attributed to intake of animal-based foods.

Campbell discusses heart disease in his book, and its relationship to consumption of animal protein (page 111). Although heart disease has been related⁶⁷ to increased fat and cholesterol intake, this correlation was not present in the China-Oxford-Cornell study data. When the data was analyzed and subjected to Pearson correlation, we see that among men, the relationship between coronary heart disease and cholesterol intake only had a p value of 0.8362, which indicates a lack of correlation. When we analyze the relationship between lipid intake and coronary heart disease among men, we only see a p value of 0.7583, again not considered significant (Figure 6.) When we analyze the correlation between dietary intake from animal sources and coronary heart disease, we get a p value of 0.8283, again considered insignificant. These relationships are confounding to many studies that we have seen relating cholesterol and fat intake to coronary heart disease. This is most likely due to higher intake of white meats from seafood in the Chinese diet compared to higher intake of red meat in most western diets. This would result in healthier fats and lower LDL levels than consumption of red meats.

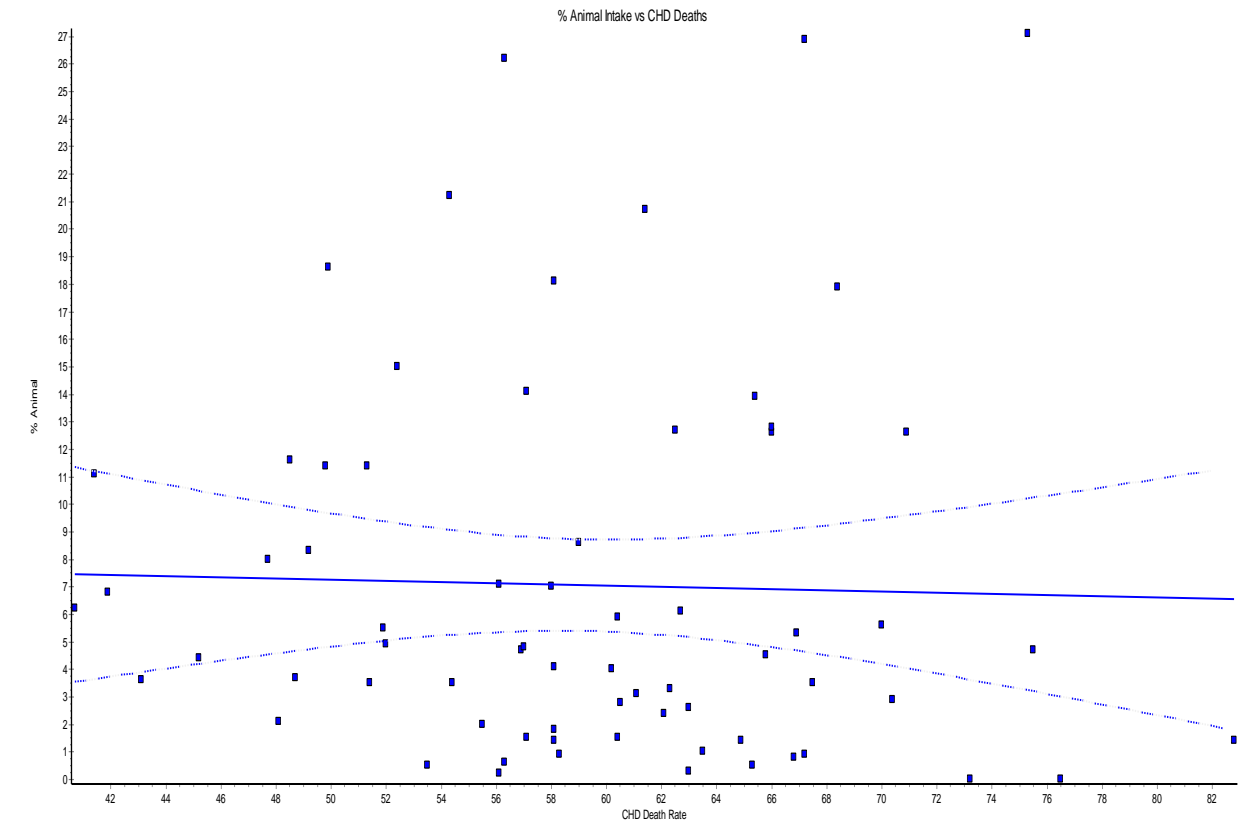


Figure 6. Coronary Heart Disease deaths when compared to the percent of diet based on animal products, yielding a p value of 0.8283 and an R value of 0.0007073. Considered not significant.

III. Differences between data and book.

When Campbell discusses each chronic disorder, he frequently draws data from other sources to support his argument against an animal-based diet. Because it would be very time-consuming to analyze these other sources to determine whether they support his arguments, we must limit the scope of this discussion to the data from the China-Oxford-Cornell study, and determine whether it supports his claims. Since the majority of his book, however is drawn from third-party sources, this approach does leave a lot of gaps of unanalyzed claims. I find it slightly troubling that he titles his book "the China Study," when in fact it is largely meta-analysis of other studies, with relatively few references to the

actual China-Oxford-Cornell study from which the title is derived. Most of us are aware that this meta-study approach leaves a lot of room for misinterpretation and can be very misleading. Hopefully someone will have the time to analyze these outside sources and determine their credibility and the plausibility behind their use for his arguments.

As we can see from the previous section, in the data from the China-Oxford-Cornell study, colon cancer cannot be directly attributed to the intake of animal protein, or cholesterol intake, with only a slight correlation between colon cancer deaths and lipid intake. While we can see from other sources that fiber intake is inversely correlated with colon cancer deaths, this is not enough to draw a conclusion that animal intake is responsible for colon cancer. While Campbell draws data from other sources to support his claim, the data in the China-Oxford-Cornell study does not support this claim.

We can see from the data that breast cancer is not correlated to animal fat intake or cholesterol. Also since the data on dairy consumption is virtually unusable, since most areas in China had almost no dairy intake at the time, and a few counties had very high dairy intake, we cannot confidently use this data to make any connections with breast cancer rates.

One thing that Campbell does seem to be right about is that liver cancer does seem to be related to the intake of animal products. We have seen a demonstrable correlation between cholesterol and liver cancer, as well as animal intake and liver cancer. It does not appear to be related to overall protein intake, probably due to the fact that the diets in the data were largely based on plant protein. We did see an inverse correlation, however between carbohydrate intake and liver cancer rates. This is likely due to a relationship between carbohydrate intake and plant intake.

Campbell also discusses several diseases for which data is not available in the China-Oxford-Cornell study. He claims that they are all related in some regard to having an animal-based diet. He draws his arguments from third-party sources, which again, we have not had a chance to analyze here,

so we cannot verify them at this juncture. He discusses obesity, and claims that it is largely nonexistent in plant-based diets (page 135). He discusses prostate cancer and says that is related to excessive animal and dairy intake, which cause elevated IGF-1 (page 177). Since prostate cancer rates are not present in the China data, and dairy data is unreliable for previously discussed reasons, we cannot assess this claim. Campbell also discusses Alzheimer's disease and states that is due to free radicals, hypertension, and elevated blood cholesterol (page 218). Again, the data on Alzheimer's disease is not present in the study, so we cannot confirm these claims. He claims that autoimmune diseases are caused by consuming too much dairy, which causes the body to begin attacking itself (page 183). Again, data regarding autoimmune diseases is not available in the China data, since it largely tracks mortality rates. In fact, a recent study suggests that consumption of raw milk may be protective against asthma and allergies, suggesting that it may actually help protect against autoimmune disorders⁸. Data is also not present in the China data for kidney stones, which Campbell states are related to animal protein intake. He also discusses macular degeneration, and claims that is inversely correlated with a plant-based diet, due largely to large amounts of antioxidants and phytonutrients present in plants (page 215). Again, data regarding macular degeneration is not present in the China data, largely because it revolves around mortality data.

IV. Conclusion

We have definitely seen several instances where Campbell's book, *The China Study* has presented some half-truths, such as blaming animal protein intake for colorectal cancer, where it is definitely due to a variety of factors. We have also seen a few instances where the data is almost entirely misrepresented, such as stating that elevated breast cancer rates are caused by excessive animal fat or cholesterol intake, where the China data disagrees. I find it equally troubling that while the book is titled *The China Study*, the vast majority of its findings are drawn from third-party studies, rather

than the China-Oxford-Cornell study data itself. Anyone can misrepresent data in such a way, and I believe that it is necessary to analyze all of these third party studies in order to determine the validity of many of his claims. Despite these facts, some of his claims are correct, such as associating liver cancer with increased cholesterol intake, or macular degeneration on a lack of dietary antioxidants. These claims are sound, and at least the liver cancer is covered in the data from the China-Oxford-Cornell study.

Table 1. Pearson R values and P-Values.	<u>All Neoplasm Deaths 0-34 y/o</u>	<u>All Neoplasm Deaths 35-69 y/o</u>	<u>Colorectal Cancer Deaths 35-69 y/o</u>	<u>Liver Cancer Deaths 35-69 y/o</u>	<u>Breast Cancer Deaths 35-69 y/o</u>
<u>Carbohydrate (g)</u>	P value = 0.0133 r = 0.09201	P value is 0.4763 r = 0.007834	P value is 0.5633 r = 0.005164	P value is 0.0110 r = 0.09544	P value is 0.0231 r = 0.07691
<u>Carbohydrate %</u>	P value = 0.1013 r = 0.04139	P value is 0.4763 r = 0.007834	P value is 0.2267 r = 0.02240	P value is 0.0047 r = 0.1166	P value is 0.0178 r = 0.08333
<u>Protein (g)</u>	p value = 0.0026 r = 0.1327	P value is 0.3522 r = 0.01333	P value is 0.8114 r = 0.0008827	P value is 0.1550 r = 0.03087	P value is 0.9674 r = 2.585
<u>Animal %</u>	p value = 0.2572 r = 0.02002	P value is 0.9117 r = 0.0001906	P value is 0.7359 r = 0.001762	P value is 0.0100 r = 0.09770	P value is 0.0033 r = 0.1252
<u>Plant %</u>	P value is 0.2571 r = 0.02002	P value is 0.9158 r = 0.0001732	P value is 0.7399 r = 0.001707	P value is 0.0100 r = 0.09776	P value is 0.0033 r = 0.1254
<u>Dairy %</u>	P value is 0.5351 r = 0.006041	P value is 0.6024 r = 0.004198	P value is 0.2660 r = 0.01900	P value is 0.6153 r = 0.003907	P value is 0.0454 r = 0.06019
<u>Calories</u>	P value is 0.0274 r = 0.07372	P value is 0.6968 r = 0.002352	P value is 0.1114 r = 0.03853	P value is 0.1248 r = 0.03586	P value is 0.1302 r = 0.03488
<u>Lipid</u>	P value is 0.4914 r = 0.007429	P value is 0.3093 r = 0.01589	P value is 0.0272 r = 0.07287	P value is 0.0756 r = 0.04777	P value is 0.1905 r = 0.02622
<u>Cholesterol</u>	P value is 0.6050 r = 0.004204	P value is 0.5639 r = 0.005148	P value is 0.1261 r = 0.03562	P value is 0.0044 r = 0.1181	P value is 0.0724 r = 0.04882

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