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ORIGINAL ARTICLE

Hypothesis: the reversal of the relation between economic growth and health progress in Sweden in the nineteenth and twentieth centuries was caused by electrification

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Abstract

The expected decline of health indicators with economic recessions and improvement with economic growth in the nineteenth century Sweden was reversed in the twentieth century, giving the counterintuitive pattern of higher mortality and lower life expectancy in economic expansions and improvement of these indices in recessions. The change or ''tipping point'' occurred at the end of the nineteenth century or early in the twentieth century when electrification was introduced into Sweden. All 5 of the reversals of annual industrial electric energy use in the US between 1912 and 1970 were accompanied by recessions with lowered GDP, increased unemployment, decreased mortality and increased life expectancy. The health indices were not related to residential electricity use. The mortality improvement between 1931 and 1932 by state in the US strongly favored urban areas over rural areas. Rural unemployment by state in 1930 was significantly positively correlated with residential electrification percentage by state in 1930. The health effects of economic change are mediated by electrical exposure.

Keywords

Death rate, dirty electricity, economic growth, economic recession, health indicators, industrial electricity use, life expectancy

History

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Introduction

The 2008 Journal of Health Economics paper, ''The reversal of the relation between economic growth and health progress: Sweden in the nineteenth and twentieth centuries'' (Tapia-Granados and Ionides, 2008) documented how the health indicators, mortality and life expectancy improved during economic expansions in Sweden in the nineteenth century, but during the twentieth century, the pattern reversed, developing the contemporary and paradoxical pattern of improved health indicators in recessions and poorer health indictors during economic expansions. Interestingly, their models indicated a ''tipping point'' late in the nineteenth century or early in the twentieth century when Sweden and the rest of the world were undergoing the shift to electric power beginning with Thomas Edison's electrification of New York City in 1882. In 1885, Siemens installed electric lighting in the Stockholm Palace (Siemens Corporate History) and in 1893 the Helisjohn–Grangesberg 10 km transmission line was built (The History of Electrification). The Swedish State Power Board was formed in 1909 (International Small Hydro Atlas). I present evidence that national electricity use and individual electrical exposure is responsible for the health indices reversal seen in Sweden and electrified countries.

Methods and results

An examination of industrial electric power use and health indicators in the US during economic recessions suggests that the Swedish reversal was mediated by electricity. Industrial electric power use in the US rose from 11,250 millions of kilowatt hours 1912 to 685,693 in 1970 (Historical Statistics of the US). There were only 5 reversals of the pattern of annual increase over those years (Table 1). Each reversal signaled a recession or depression associated with a GDP decline, an increase in unemployment, an increase in life expectancy and a decrease in the death rate. During the great depression, industrial electric use declined by 10%, while residential use declined by only 1%. It is the industrial electricity use, not the residential use that seems to be driving the mortality and life expectancy changes. In 1930–1933 the mortality decrease and life expectancy increase was seen in both males and females, whites and non-whites for most age groups. Most major causes of death had lowered death rates. Suicides increased and motor vehicle accidents decreased during the great depression. I think that the health indices are responding to a lower individual environmental electricity exposure during recessions. Table 2 shows the change in death rate in 45 US states in the great depression between the years 1931 and 1932 (US Vital Statistics). The death rate

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Table 1. Total industrial electric energy use decline by year, United States between 1902 and 1970; GDP, unemployment, life expectancy and death rate.

Year	Millions of Kilowatt-hours	GDP decline[a] percent	unemployment percent	Male life expectancy years	Death rate/1,000
1920	31,500	38.1[b]	–	53.6	13.0
1921	28,000			60.0	11.5
1929	55,122	26.7	−24.9	58.7	11.9
1932	43,504			63.5	10.9
1937	64,757	18.2	−19.0	58.0	11.3
1938	58,452			61.9	10.6
1941	145,015	12.7	−5.2	66.8	10.6
1946	125,498			69.4	10.0
1957	326,455	3.7	−7.5	72.7	9.6
1958	319,258			72.9	9.5

[a]Peak to trough.
[b]Business activity.

Table 2. Change in death rate, United States 1931–1932 by urban and rural areas for 45 US states.

Death rate	Urban (10,000 + population)		Rural	
	No	percent	No	percent
Decreased	31	68.9	19	42.2
Increased	11	24.4	23	51.1
Unchanged	3	6.7	3	6.7
Total	45	100.0	45	100.0
$p < 0.001$				

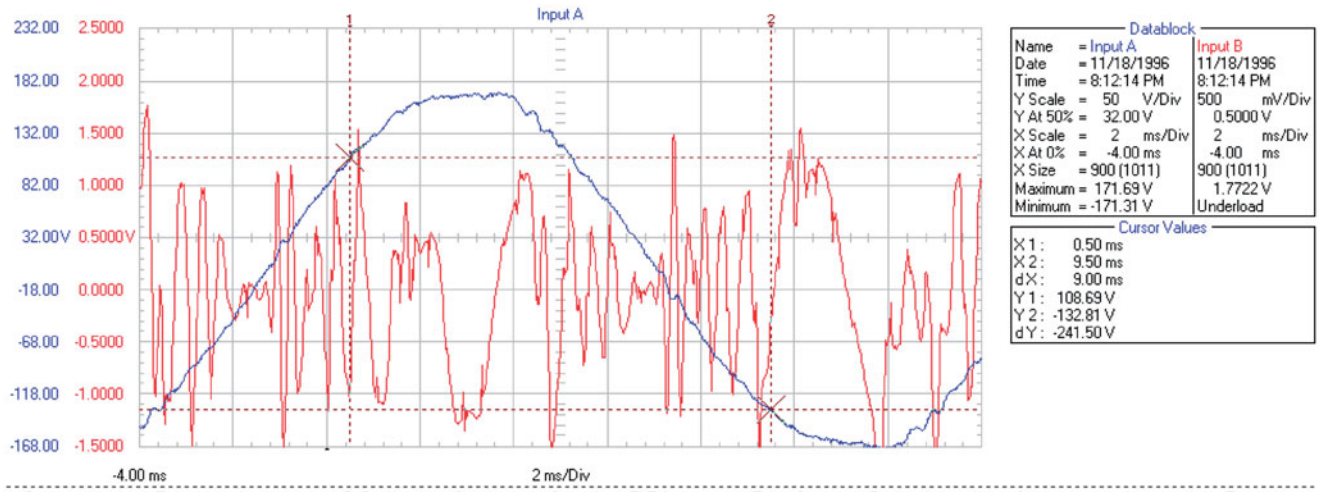
decrease was greater in urban areas with higher levels of electrification than in rural areas. Over 50% of states had a mortality increase in their rural areas. Rural unemployment (percent of gainfully employed workers) by state in 1930 (US Census, 1930) was significantly positively correlated with residential electrification percentage by state in 1930 ($r = 0.714$, $r^2 = 0.525$, $p = <0.0001$; Vassar statistical computation website).

Discussion

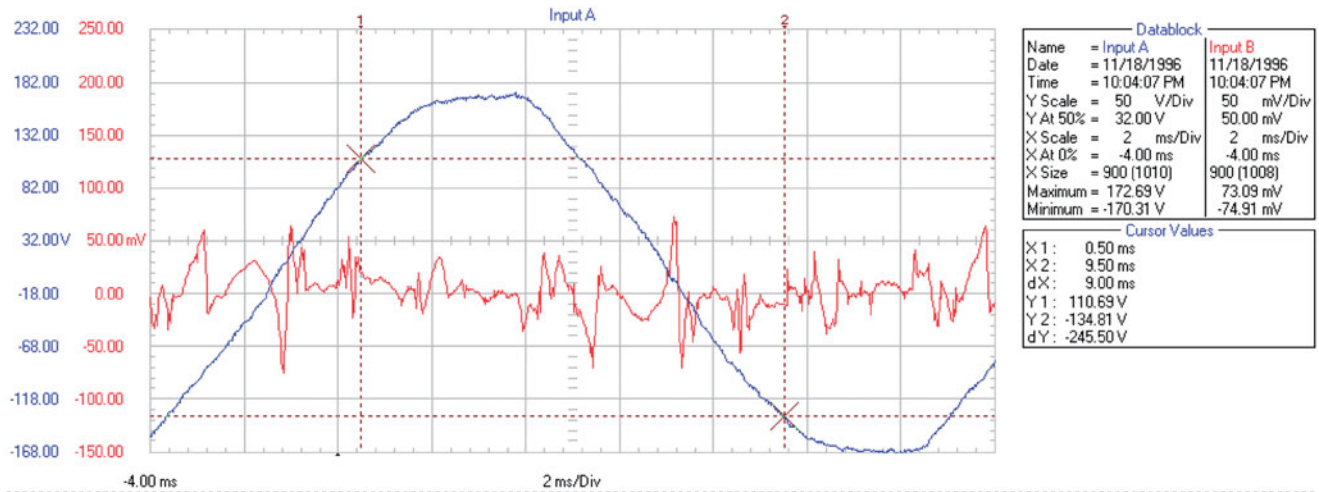
I think that the paradoxical improvement of health indices in occupied Europe during World War II was not due to caloric restriction, but to lowered industrial electrical use and individual electrical exposure. Cuba has had a similar, more recent experience. When Russian support of Cuba ended in 1990, and Cuba lost many of its trading partners, the GDP dropped at least 35% and total electric use dropped 25% between 1989 and 1993 (Cuba Foundation). Industrial and construction electric consumption dropped from about 5900 GWh to about 3200 GWh in 2003 (Belt, 2008). As late as 2008, industrial electric consumption had only recovered to about 4100 GWh. As in the Great Depression in the US, residential electricity use in Cuba declined only slightly, and had recovered to pre-1990 levels by 1996. Hurricanes and generator failures resulted in frequent blackouts. In 1995, 297 days saw some interruption of electrical service (Focus on Cuba). In 2005, some blackouts lasted 12 hours (Havana Journal, 2005). In the period 1997–2002, there were declines in mortality due to diabetes, coronary heart disease and stroke which were ascribed to caloric restriction and weight loss (Franco et al., 2007). Male life expectancy at birth has risen steadily from 72.8 years in 1990 to 76.8 years in 2008 with brief leveling at 74.5 years in 1999 and 2000. Female life expectancy had a similar pattern with a slight decrease between 1999 and 2000 (Trading Economics, 2012).

Over the past 40 years, I have developed information showing that electricity is responsible for most human disease beginning with the onset of electrification. In 1982, I showed that electrical workers had increased mortality due to leukemia (Milham, 1982). In 2001 Ossiander and I demonstrated a striking correlation between the emergence of the childhood mortality age 2–4 peak of common acute lymphoblastic leukemia and the spread of residential electrification in the US in the 1930s and 1940s. At ages 2–4, there was a 24% increase in leukemia mortality for a 10% increase in percent of homes served by electricity (Milham and Ossiander, 2001). This age peak is still not seen in places without electrification. In 2009, I used historical US Census residential electrification data and US mortality data to show that electrification probably caused the twentieth century epidemic of the ''diseases of civilization'' including cardiovascular disease, diabetes, cancer and suicide (Milham, 2010 a, b). This study exploited the fact that in the first part of the twentieth century, most US urban populations were electrified and electrification of rural populations was correlated with the state level of residential electrification. Both populations were covered by the same vital registration system. Most US cities were electrified by the early 1900s. By 1930, over 90% of residences in California, Connecticut, Massachusetts, New Jersey, New York and Rhode Island were electrified. By contrast, many southern states had less than half of their residences electrified. In 1930, 19% of residences Mississippi were electrified. Alabama, Arkansas, Georgia, New Mexico and South Carolina had less than 40% of residences electrified in 1930. In states with high electrification levels, rural and urban mortality rates were similar. In states with low electrification levels the urban mortality rates were much higher than the rural rates. Rural death rates were significantly correlated with the state level of residential electrification for most causes. The authors of the 1930 US vital statistics report noted a 58.2% cancer mortality excess in urban areas, but it raised no red flags. The census bureau residential electrification data was obviously not linked to the mortality data. Epidemiologists in that era were still concerned with the communicable diseases.

In 2008, a cohort cancer incidence analysis of a California middle school teacher population showed a positive trend of increasing cancer risk with increasing cumulative exposure to high frequency voltage transients (dirty electricity) on the classroom's electrical wiring measured with a Graham/Stetzer (G/S) Microsurge Meter (Stetzerelectric.com) The attributable risk of cancer associated with this exposure was 64%. A single year of employment at this school increased a teacher's cancer risk by 21% (Milham and Morgan, 2008). Figure 1 shows an oscilloscope tracing of dirty electricity. Before the introduction of non-linear loads like personal computers and most modern electrical equipment, the major sources of dirty electricity were brushed generators and electric motors. This may account for the fact that it is



The waveform was collected in the office of Cheryl Heywood, Manager of the Olympia Timberland Library, Olympia, WA. Channel A was connected to the 120 VAC wall receptacle. Channel B was connected to the same potential, except through the ubiquitous filter (removes the 60 cycle) No Graham/Stetzer filters were used at the time. The Microsurge Meter readings were 11,190 at the time.



The waveform was collected in the office of Cheryl Heywood, Manager of the Olympia Timberland Library, Olympia, WA. Channel A was connected to the 120 VAC wall receptacle. Channel B was connected to the same potential, except through the ubiquitous filter (removes the 60 cycle) Several Graham/Stetzer filters were used at the time. The Microsurge Meter readings were 39 at the time.

Figure 1. Oscilloscope tracing of the dirty electricity in a wall outlet in the director's office Olympia, Timberland Library before and after installing Graham/Stetzer filters. (The date and time in the data blocks are incorrect. These tracings were taken on 10/10/2011 between 9 and 11 AM).

industrial, not residential electricity use that is correlated with health indices. Dirty electricity is caused by arcing, sparking and anything that interrupts current flow, especially modern switching power supplies. Thomas Edison complained that his original ''Jumbo'' generators had serious commutator brush arcing, so dirty electricity has been here since the electric grid was established.

The Old Order Amish, a Mennonite sect who live without electricity, have had a life expectancy of over 70 years for the past 300 years (Shuldiner and Sorkin, 2003). They have very low rates of cancer (Westman et al., 2010), diabetes (Hsueh et al., 2000), cardiovascular disease (Hamman et al., 1981) and suicide (Kraybill et al., 1986).

Conclusion

I believe that the onset of electrification in Sweden can explain the reversal seen in twentieth century health indicators from the nineteenth century pattern of health improvement with economic improvement. It can also explain the disease patterns in the electrified world. I predict that the health effects of the current US recession and future

recessions will be dampened and hard to discern, because the major individual exposures to electromagnetic fields and dirty electricity are now of non-industrial origin.

Declaration of interest

I have no conflicts of interest to report.

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