

Exploring the Relationship Between Environmental Degradation, Obesity, and Economic Growth

Can Zhao*

Faculty of Business, Economics and Law, The University of Queensland, Brisbane, 4067, Australia

*Corresponding author. Email: can.zhao@uqconnect.edu.au

ABSTRACT

Environmental degradation and obesity are becoming severe since the beginning of the 21st century. Meanwhile, some of the researchers mentioned there should be relationships between economic growth and these two problems respectively. The evaluation of validation of Environment Kuznets curve and Obesity Kuznets Curve has been a famous approach to confirm the nexus between the variables in the history. This paper tried to explore what is the connection between economic development, obesity, and environmental deterioration by analyzing the historical evidence of Obesity Kuznets Curve and Environmental Kuznets Curve and observed that there are inverted U relationships between economic progression and obesity, economic progression and the degree of pollution respectively.

Keywords: Obesity, Environment, Economic Growth, Kuznets Curve.

1. INTRODUCTION

The increment in the world economy and population size increases the demand for natural resources and worsens the energy crisis. The United Nations Environment Programme confirmed that the global climate change is becoming severe in the "global environment outlook 2000" and pointed out that during the seven years after the 1992 United Nations Conference on environmental development the overall global environment has deteriorated. The main reason for the degradation is the inefficient production of many industrialized countries. The emission of toxic and greenhouse gases hasn't been falling but rising. In many developing economies, a huge amount of productive natural resources are polluted and wasted by the deterioration of the ecological environment and inefficient production respectively. In 1999, the report from World Wide Fund for Nature or World Wildlife (WWF) indicated that almost 10% of the forest vanished from 1970 to 1995. Meanwhile, the severe change in the climate has increased the speed of animal extinction and the degree of natural fuel resources pollution, which would directly affect the stability of civilization.

At the same time, Obesity is becoming one of the most crucial problems of humankind. Obesity is not only one of the vital issues of human health but also one

of the most crucial effects of economic growth. The report of the World Health Organization (WHO) mentioned that almost 40% of adults were overweighted and 13% were obese in 2016. At the same time, 340 million people who were under 19 and over 5 years old had the health issue of obesity or being overweighted. Because of obesity, the average life span has decreased by 3 years during these years. Meanwhile, being overweight take up almost 1.7 trillion of health spending in 2018. This expenditure equals the income of almost 790,000 full-time job workers in development countries and 2.8% of the total world's Gross Domestic Product (GDP).

WHO exploited the Body Mass Index (BMI) as the estimator for body health in their report in 2016. The formula of the calculation of BMI is $weight(Kg) / height(cm)^2$. If the index of a person is over 25, then this person is over-weighted. A person would be seen as obese if his or her index is over 30.

As obesity makes a significant effect on human health and economic growth, it automatically interests the people who are in the academic areas. In recent years, economic research has revealed several relationships between obesity and economic indicators. In the study by Abegunde, Mathers, Adam, Ortegon, and Strong, they found that obesity and economic

growth are closely related in developing countries [1]. By analyzing the mechanism behind the relationship among obesity and income he found out that obesity and disposable part of GDP per capita was negatively connected. He said that people with low income would like to consume unhealthy food. This kind of food which contains high energy and low nutrition is one of the main reasons to cause obesity. But the study of Seydel, Kucukoglu, Altinbas, Demir, and Yilmaz showed a different result [2]. The study tried to find out the main causes of worldwide liver cancers. During the research, the researchers analyzed historical studies and used data from different countries from 2002 to 2014 and found out that obesity played a vital role in impacting the health of national population and it is one of the main factors that cause liver cancers. The result showed that chronic liver disease in developed countries caused by obesity was more than that in developing countries. It means that, the more developed of the economy the more risk to be over-weighted. As different researches results showed different relationships between economic growth and obesity in different countries.

The argument that drives the discussion was whether high-quality food is the main factor to increase civil body weight or not. Some of the researchers announced that a higher average body-weight of people is part of the economic growth because of declining prices of food and rising GDP per capita so that people would be able to consume enough food. The more food they consume, the more average body weight there will be. Some of the researchers argued that low-quality food was the main resource of obesity. people in the low-income group are simply not afforded for good quality food to gain enough nutrition compare to the people who are with high incomes. Therefore, in the process of economic growth, people with high income would more likely to be slimmer.

Minos, Butzlaff, Demmler, and Rischke found out that there is an interrelationship between economic growth and obesity meanwhile there was a one-way connection between environmental degradation to economic development, and obesity [3]. The article mentioned that the economic growth at the expense of environmental degradation would also causes a circle of deterioration. environmental degradation would not only destroy the natural resources but also damage the health of humankind. In the paper, they explained that climate change would induce people to become more weighted because of climate deterioration, and environmental degradation. People would choose to hire transportation and do less physical exercise. As people’s health becomes worse, their productivity would also be negatively affected.

Thus, the question highlighted by this paper is: what is the nexus between economic development, environmental degradation, and obesity? The research which focused on the interrelationship among economic advancing and both environmental deterioration and obesity remains few. Thus this paper would be helpful for the researchers who want to fill the gap and further their empirical studies in this area.

This paper tried to answer this question by integrating and analyzing the articles from Google Scholar with the keywords “Environment Kuznets Curve”. “Obesity Kuznets Curve”, “relationship” “economic growth and obesity”, “economic growth and environment” and “economic growth and climate change” from 2012 to 2022 in the main body. Because the studies which used Kuznets Curve to observe the nexus between economic development and obesity are pretty rate, during this study, only 7 articles shown in Table 1 are found and analyzed. By this trend, this paper would point out a direction of the OKC for further studies in the conclusion session.

Table 1. Studies about OKC

Author	Tittle	Model	Variables	Data	Result
A.Grecu K. Rotthoff	Economic growth and obesity: findings of an Obesity Kuznets curve	monotonic polynomial regression with panel data	Dependent: BMI Independent: Income	State level panel from 1991 to 2010	OKC hypothesis validated
M. Aydin	The effect of economic growth on obesity for the most obese countries: new evidence from the obesity Kuznets curve	unrestricted error correction model	Dependent: BMI Independent: GDP per capita, Unemployment	top 20 obese countries from 1991 to 2016	OKC hypothesis validated in Oman, Saudi Arabia, Turkey and the United Arab Emirates.

Y. Go L.Lau A. Ng T. Yiew	Obesity Kuznets curve hypothesis and global warming: a robust estimation under cross-section dependence	robust to cross-section dependence	Dependent: prevalence of obesity Independent: Income, CO2 emission, Food production index	panel of 165 countries and annual data from 2000 to 2014	OKC hypothesis validated
N. Windarti S. Hlaing M. Kakinaka	Obesity Kuznets curve: international evidence	Fixed effects regression model	Dependent: BMI Independent: log of real GDP per capita, weight-related health status	country-level panel data of 130 countries during the period from 1975 to 2010	OKC hypothesis validated
A. Alola F. Bekum	Obesity Kuznets curve and the reality of economic ellipsoids (EIE)	autoregressive distributed lag techniques	Dependent: MBI Independent: Global Network, GDP, Life expectancy	time-series data of annual frequency from 1975 to 2016	OKC hypothesis validated
T. Hojjat J. Ruiz	Obesity, Economic Growth: The COVID-19 Pandemic, and Poverty	dynamic panel data analysis	Dependent: BMI Independent: GDP per capita, Poverty rate for women	Panel data of Peru during the period 2008-2020	long-run relationship between the variables
G. Egger	Economic growth and obesity: An interesting relationship with world-wide implications	Spline regression analyses	Dependent: BMI Independent: GDP, mean happiness scores, carbon footprint per capita	country-level panel data of 175 countries for the year 2007	OKC hypothesis validated

2. RELATIONSHIP BETWEEN ECONOMIC DEVELOPMENT, OBESITY, AND ENVIRONMENTAL DEGRADATION

2.1. Relationship between Obesity and Economic Growth

The Obesity Kuznets Curve hypothesis (OKC) is becoming one of the most popular hypotheses among the researchers who want to test the nexus between economic advancing and obesity recently because almost all results of historical studies have shown that the relationship between obesity and economic development is non-linear. OKC is derived from the environmental Kuznets curve (EKC). EKC was advanced by Simon Kuznets in the 1950s in the research on the nexus among per capita income and several variables which reflect environmental degradation at the

beginning. It indicated that there was a non-linear connection between economic progressing and pollution. Recently, the Kuznets Curve hypothesis was found could be available not only in exploring the nexus between GDP growth and pollution but also in other areas. OKC hypothesis, in which BMI is used as the indicator of body health degradation instead of the environmental degradation variables, is used to reveal the connection among obesity and economic advancement. Meanwhile, an economic indicator such as GDP or GDP per capita is always used as the independent variable in OKC.

Historical research showed different relationships between obesity and economic growth in different countries. Even some of the researches found out the different relationship in on country in different period of time. The results could be shortened to a positive relationship and a negative relationship. When the nexus

between obesity and economic development is positive, the number of over-weighted people will increase if GDP increases. On the other hand if the nexus between obesity and development of economy is negative, the number of people who is obese decreases if there is economic growth.

Egger tried to confirm the nexus between obesity and economic development in English-speaking countries, European countries, and Asian countries in 2007 [4]. The result of the research indicated that there was a positive relationship between GDP and BMI in Asian countries because the slope of the tangent line is positive. Meanwhile, the slope of the tangent line of the Asian countries is steeper than that of the developed countries, the steeper the slope of the line the stronger the trend of people gaining more weight. This symptom indicates that countries with worse economic development would make people gain more weight when there is economic growth compared to that of the higher economic developed countries with the same economic growth. Grecu and Rothhoff also tried to test the validity of OKC with the worldwide state-level panel data from 1991 to 2010 by the monotonic polynomial regression with panel data and found out that the nexus between the two indicators, GDP and BMI, was shaped as an inverted U [5]. N. Windarti, Hlaing, and Kakinaka used the logarithm of real GDP per capita as the proxy for economic development and found the same result [6].

Among the papers in Table 1, 5 papers tried to estimate the applicability of OKC by hiring new indicators except BMI and GDP or Income to reduce the bias. Aydin investigated the validity of OKC by the unrestricted error correction model with the data of the top 20 obese countries from 1991 to 2016 [7]. In the research, the author added a new indicator (unemployment rate) to reduce the bias of the result. The paper found out that OKC is not valid in all 20 countries. OKC is found valid in Only 4 countries, there are interrelationships or no relationship between GDP and BMI in some of the other countries. Windarti, Hlaing, and Kakinaka exploited the weight-related health status of 130 countries and found the same connection between economic development and obesity [6]. The study of Alola and Bekum put life expectancy as an indicator of health in an auto-regressive distributed lag model with time-series data from 1975 to 2016 and confirmed that OKC was valid [8].

Hojjat and Ruiz, used panel data analysis with panel data from 2008 to 2020 with dependent variable BMI and independent variables GDP per capita and the poverty rate for women to test the validity of OKC in Peru and discovered the long-run nexus between GDP and BMI [9].

2.2. Relationship between Environmental Degradation and Economic Growth

Intuitively, the developed nations would like to provide the goods made by advanced technology and attached services compared to the goods produced by the traditional heavy industry. That's why they would be less dependent on the burning of fuel than the under-developed or developing countries. CO₂ emission was used as the proxy of fuel consumption by Grossman and Krueger and many other researchers in their research [10]. According to the data of CO₂ emissions from 2000 to 2018 collected by the world bank, CO₂ emissions of high income countries have been decreasing meanwhile, CO₂ emissions of middle income countries have been rising during these years. That's also why on the right-hand side of the turning point of EKC, the more decadent the society, the more demand for the protection of the environment, thus the better environment and less CO₂ emission. On the other hand, the developing and under-developed countries are more dependent on the products made by heavy industry because of the under-developed technology. That is why the economic growth of developing and under-developed countries often accompanied by environmental degradation.

There are many pieces of research that tried to estimate the nexus between pollution and economic development to test the applicability of Environmental Kuznets Curve (EKC) hypothesis in history. EKC, firstly introduced by Grossman and Krueger, is becoming the most popular hypothesis used for issuing economic policies [10]. EKC is an inverted U shape curve, just like OKC. The x-axis in EKC indicates the income. If the point move along OKC from left to right, the income increases, which means the economy is improved. The y-axis in EKC indicates the degree of pollution, if the point move along OKC from up to down, the environment is improved. There is a turning point in the peak of EKC. This turning point shows the worst degree of the pollution. This specific point could also be used to classify whether there is an environmental degradation or an environmental improvement. The left-hand side of the turning point shows environmental degradation. In the environmental degradation area, economic growth would diminishingly increase environmental pollution. The right-hand side of the turning point shows environmental improvement. It indicated that the environment would be improved at an increasing rate if the economy kept growing.

Before EKC was introduced, Grossman and Krueger had revealed that GDP and two environmental variables are non-linear related in the research they tried to estimate the nexus among the quality of air and economic development by the Global Environmental Monitoring System in 42 countries [11]. The two related

indicators in the model were sulfur dioxide (SO₂) and economic growth. The result of the study grossly indicated that economic growth could worsen air quality. Whereas, after the turning point of the Inverted U shape, the relationship between the two variables is inverted. Shafik, did the research with the same variables and economic models, in which Shafik tried to estimate the relationship between environmental degradation and the raising GDP per capita with data from 149 countries from 1960 to 1990 [12]. The result indicated the validity of the EKC model in most middle-income countries.

Stern revealed that in his study that tried to estimate the nexus between environmental degradation and income, not all the ecological index shows significant evidence that EKC is applicable in 1998 [13]. Even though EKC was empirically proved in some studies, some inconsistent results among the historical analyses show that increasing income will improve the environment.

The test of the validity of EKC also interested economic researchers in recent years. Hasnisah, Azlina and, Taib tested the nexus between GDP, CO₂ emission, and consumption of renewable energy by Ordinary Least Squares (OLS) [14]. The data is from Asian developing countries from 1980 to 2014. The result of the research indicated that all the variables are significant. Thus there is a positive between all three indicators. The result showed that with further economic growth and energy consumption, the environment would become worse. At the same time, Qiao, Zheng, Jiang, and Dong proved that economic growth is significantly improved by pollution all over the world [15]. Done mentioned that the CO₂ emission would not only cause pollution, but also damage people's health, slow down economic progressing, and destroy the balance of nature. The article also stated a negative relationship between CO₂ emission and the consumption of renewable resources.

2.3. Interlinks between Economic Development, Environment, and Obesity

Rischk and his research companions indicated the relationship between GDP, BMI, and CO₂ emission in their reviews in 2016 [3]. They tried to confirm that there are direct interrelationships between GDP growth and obesity by analyzing the historical evidence. Meanwhile, CO₂ emissions will directly improve economic growth and indirectly increase the rate of people who are obese.

Y. Go, L. Lau, C. Ng, and T. Yiew used a robust cross-section dependence model with panel data from 165 countries from 2000 to 2014 [16]. During the study, aside from BMI and Income, CO₂ emission, and food production index were hired and the square relationship between BMI, Income and CO₂ was found significant.

3. CONCLUSION

All in all, by analyzing the historical papers, in most of the papers, OKC and EKC were proven valid. Environment or obesity has a non-linear nexus with economic development respectively in most of the countries in the world.

As the studies that focus on the relationship between environment, obesity and economic growth are rare, further studies are recommended to put economic, environmental, and obese indicators into the model at the same time. Simultaneously, future research could focus on exploring the nexus between pollution and human being health. In order to exclude the effect of exogeneity, the IV regression model is recommended for testing the relationship between environment and obesity.

REFERENCES

- [1] D. Abegunde, C. Mathers, T. Adam, M. Ortegón, K. Strong, The burden and costs of chronic diseases in low-income and middle income countries, in: *The Lancet*, vol. 370, 2007, pp. 1929–1938. DOI: [https://doi.org/10.1016/S0140-6736\(07\)61696-1](https://doi.org/10.1016/S0140-6736(07)61696-1)
- [2] G. Seydel, O. Kucukoglu, A. Altinbas, O. Demir, S. Yilmaz, Economic growth leads to increase of obesity and associated hepatocellular carcinoma in developing countries, in: *Annals of Hepatology, Concise Review*, vol. 15, 2016, pp. 662–672. DOI:10.5604/16652681.1212316.
- [3] D. Minos, I. Butzlaff, K. Demmler, R. Rischke, Economic growth, climate change, and obesity, in: GJ Egger (Eds), *Economy and Environment*, vol. 5, 2016, pp. 441–448. DOI 10.1007/s13679-016-0234-7
- [4] G. Egger, Obesity, chronic disease and economic growth: a case for “big picture” prevention, in: SAGE-Hindawi Access to Research Advances in Prevention Medicine, *Lecture Notes in Computer Science*, 2011, pp. 6. DOI: 10.4061/2011/149158
- [5] A. Grecu, K. Rotthoff, Economic growth and obesity: findings of an obesity Kuznets curve, in: *Applied Economics Letters*, vol. 22, 2015, pp. 539–543. DOI: 10.1080/13504851.2014.955251
- [6] N. Windarti, S. Hlaing, M. Kakinaka, Obesity Kuznets curve: international evidence, in: *Public Health*, vol. 169, 2019, pp. 26–35. DOI: <https://doi.org/10.1016/j.puhe.2019.01.004>
- [7] M. Aydin, The effect of economic growth on obesity for the most obese countries: new evidence from the obesity Kuznets curve, in: *The European*

- Journal of Health Economics, vol. 20, 2019, pp. 1349–1358. DOI: <https://doi.org/10.1007/s10198-019-01099-2>
- [8] A. Alola, F. Bekum, Obesity Kuznets curve and the reality of eco-income ellipsoids (EIE), in: *The European Journal of Health Economics*, vol. 22, 2021, pp.1095-1101. DOI: <https://doi.org/10.1007/s10198-021-01308-x>
- [9] T. Hojjat, J. Ruiz, Obesity, economic growth: the COVID-19 pandemic, and poverty, in: *The Journal of Applied Business and Economics*, vol. 23, 2021, pp. 11-34.
- [10] G. Grossman, A. Krueger, Economic growth and the environment, in: *The Quarterly Journal of Economics*, vol. 110, 1995, pp. 353–377. DOI: <https://doi.org/10.2307/2118443>
- [11] G. Grossman, A. Krueger, Environmental impacts of a north American free trade agreement, in: *National Bureau of Economic Research Working Papers No 3914*, 1991, DOI: <https://doi.org/10.3386/w3914>
- [12] N. Shafik, Economic growth and environmental quality: time series and cross-country evidence, in: *Office of the Vice President Development Economics The World Bank*, 1992
- [13] D. Stern, Progress on the environmental Kuznets curve, in: *Environment and Development Economics*, vol. 3, 1998, pp. 173 – 196. DOI: <https://doi.org/10.1017/S1355770X98000102>
- [14] A. Hasnisah, A. Azlina, C. Taib, The Impact of renewable energy consumption on carbon dioxide emissions: empirical evidence from developing countries in Asia, in: *International Journal of Energy Economics and Policy*, vol. 9, 2019, pp. 135–143.
- [15] H. Qiao, F. Zheng, H. Jiang, K. Dong, The greenhouse effect of the agriculture-economic growth-renewable energy nexus: Evidence from G20 countries, in: *Science of The Total Environment*, vol. 671, 2019, pp. 722–731. DOI: <https://doi.org/10.1017/S1355770X98000102>
- [16] Y. Go, L. Lau, C. Ng, T. Yiew, Obesity Kuznets curve hypothesis and global warming: a robust estimation under cross-section dependence, in: *Environmental Science and Pollution Research*, vol. 28, DOI: <https://doi.org/10.1007/s11356-021-13264-3>