Obesity and thrifty genotype: biological and social determinism versus free will

Juan Garduño-Espinosa*, Diana Ávila-Montiel, Ana G. Quezada-García, Carlos A. Merelo-Arias, Violeta Torres-Rodríguez and Onofre Muñoz-Hernández

Hospital Infantil de México Federico Gómez, Mexico City, Mexico

Abstract

Obesity is a global public health problem with a concerning increasing rate and no conclusive answer related to its causes. The thrifty genotype, proposed by James V. Neel in 1962, is one of the many hypotheses that intend to explain the epidemic. Neel proposed that genetic variations in hunter-gatherer communities—which were selectively favorable in the past since they allowed to confront famine—are currently a disadvantage because food is plentiful and relatively constant. This conclusion remains valid despite being highly criticized. This review discusses that the hypothesis of the thrifty genotype supports an explicative approach based on biological determinism. This approach, such as social determinism, underestimates the role of individuals as free entities responsible for their own behavior. While a drastic change in the current theoretical framework occurs, in which individuals are considered as independent, free and self-responsible agents with the ability to overcome their heredity and their environment, the idea that the obesity pandemic cannot be explained or solved will be present. Although the influence of these elements in behavior is not rejected, it is proposed that behavior potentially and mainly comes from free will, which is neither biologically nor socially determined.

Key words: Obesity. Thrifty. Genotype. Behavior. Determinism.

La obesidad y el genotipo ahorrador. Determinismo biológico y social versus libre albedrío

Resumen

La obesidad es un problema de salud pública mundial con un crecimiento alarmante para el cual no se han encontrado respuestas concluyentes en relación con sus causas. Entre las múltiples hipótesis que intentan explicar la epidemia, se encuentra la del genotipo ahorrador, propuesta por James V. Neel en 1962. Neel propone que las variaciones genéticas en comunidades cazadoras-recolectoras que fueron selectivamente favorables en el pasado —ya que permitieron enfrentar episodios de hambruna—, se convierten en una desventaja en la actualidad cuando los alimentos se han vuelto abundantes y son relativamente constantes. A pesar de tener muchos críticos, la conjetura de Neel permanece vigente. En este artículo se argumenta que la hipótesis del genotipo ahorrador apoya un enfoque explicativo basado en el determinismo biológico. Esta postura, al igual que la del determinismo social, subestiman el papel del individuo como un ente libre y responsable.

Correspondence:

*Juan Garduño-Espinosa

E-mail: juan.gardunoe@gmail.com

Date of reception: 21-11-2018

Date of acceptance: 08-01-2019

DOI: 10.24875/BMHIME.M19000063

Available online: 14-01-2020

Bol Med Hosp Infant Mex. 2019;76:100-105

www.bmhim.com

2444-3409/© 2019. Hospital Infantil de México Federico Gómez, published by Permanyer México SA de CV, all rights reserved.

Se hace la consideración de que la pandemia de obesidad no podrá ser explicada ni resuelta en tanto no ocurra un cambio drástico en el marco teórico prevalente en el que se incorpore el enfoque de que el individuo es un agente independiente, libre y responsable de sí mismo, con la capacidad potencial de colocarse por encima de su herencia biológica y del ambiente que lo rodea. No se rechaza la influencia de la biología y el entorno social en la conducta, pero se propone que esta se deriva de manera primordial de decisiones fundadas en el libre albedrío, el cual no está determinado ni biológica ni socialmente.

Palabras clave: Obesidad. Genotipo. Ahorrador. Conducta. Determinismo.

Introduction

Obesity is defined as an abnormal or excessive accumulation of fat as a result of a caloric intake higher than the required.¹ This disorder is considered multifactorial in which environmental factors participate, mainly the increase in food availability and reduced opportunities for doing physical activity, as well as genetic factors. In the last 50 years, obesity has become a public health problem worldwide, with an alarming growing incidence in both developing and fully developed countries. In developing countries, the prevalence of obesity has increased by three times, while in Europe there has also been a significant increase, albeit smaller.²

In Mexico, the National Survey of Health and Nutrition 2012 (ENSANUT 2012, for its acronym in Spanish) reported that the prevalence of overweight and obesity in adults presented a substantial increase compared with the same survey in 1988. For example, in that year, 9.5% of adult women were obese. Conversely, in 2012, 35.2% of women presented obesity, which is a relative increase of 273%, and 25.7% in absolute terms.³⁻⁵

Obesity is not primarily an aesthetic problem or of individual and social functionality. The problem lies, above all, in the damage to the subject constitution at different organization levels: cellular, tissue, and systemic. Substantial evidence shows that obesity is strongly associated with various comorbidities: increases the risk of diabetes, cardiovascular disease, and premature death, among other diseases.

One of the hypotheses with the higher explanatory power to understand the origin of this epidemic is the hypothesis of the thrifty genotype. This idea arose from the contributions of James Van Gundy Neel, the American geneticist who proposed it in the 1960s.

James Van Gundy Neel

He was born on March 22, 1915, in Hamilton, Ohio, and died on February 1, 2000. He graduated as a Bachelor of Arts in 1935 at the College of Wooster (Ohio), where

he began his career working on *Drosophila* genetic variations. This research helped him to lay the foundations for his scientific research on evolutionary forces.^{6,7}

During his stay in the army, Neel was in contact with diseases such as thalassemia. This contact convinced him that genes are fundamental to understand human morbidity, which led him to become a specialist in genetics.⁸ In 1956, he founded the Department of Human Genetics at the University of Michigan. This department was distinguished because it encouraged greater intellectual depth in addressing problems rather than just following scientific fashions. Neel contributions include his active participation in the development of genetic epidemiology, as well as the incorporation of genetic approaches to complex chronic diseases.^{7,8}

Neel emphasized the need to understand the local micro-demographic events that constitute key elements in understanding the human evolutionary processes. He recognized that the cultural changes that accompanied the progression of the tribal societies towards urbanization created new environments with significant consequences on human health. Derived from this and other observations, his hypothesis of the thrifty genotype emerged, which suggests that there is a higher susceptibility to diseases, such as diabetes, in modern society because of the conserved genotypes that were advantageous in ancestral environments.^{7,8}

The relevance of his contribution lies mainly in the use of basic biological and evolutionary principles to explain the genetic variation of populations in their natural state, which has allowed to establish a better understanding of genetic causality.⁸

The thrifty genotype: mutations and genetic variation in natural environments

Neel joined a group of researchers who established close contact with the hunter-gatherer tribes of South America after being invited by Napoleon Chagnon, the anthropologist who initiated the study of the tribes of the Amazon basin. Initially, in the 1960s, Neel participated in an incursion with the Xavante, a tribe recently found

in the Mato Grosso of Brazil. Shortly after, he also visited the Yanomamö, a hunter-gatherer tribe located on the Brazil-Venezuela border. For 30 years, he continued his work in a large number of villages, and with at least another 20 tribes of South and Central America, providing a formidable set of data that provided a unique and perhaps unrepeatable revelation in the evolutionary biology of humans.⁹

The identification of a wide variety of polymorphisms and the study of hemoglobinopathies and thalassemias, among other diseases, are among the most prominent contributions made by Neel and his research group. The numerous analyses and results derived from these data significantly influenced the perception of human genetic diversity. Other contributions were the discovery of the role of sociocultural practices, kinship relations within and between tribes, and the description of the ecology of tribal societies, which led to the identification of different physiological profiles and disease patterns. For example, blood pressure and glucose levels in those tribes were radically lower than those seen in contemporary urban populations.¹⁰

James Neel worked much of his life with Chagnon, who became a well-known anthropologist at the American Academic milieu for his work in indigenous communities, such as the Yanomamö. The work by Neel and Chagnon was not only of anthropological interest but also had historical and political relevance since it allowed to broaden the vision of how ancestral hunter-gatherer communities lived more than 10,000 years ago, a knowledge which allowed a deeper understanding of the past of human species and, thus, a better understanding of the present.¹¹

In 1962, Neel introduced the hypothesis of the thrifty genotype as a predisposing factor for type 2 diabetes mellitus and obesity under the argument that genetic variations favorable in ancient hunter-gatherer populations to face famine episodes have now become disadvantageous due to the high availability of food. In the words of Neel himself: "A thrifty genotype becomes detrimental with progress".¹²

In an anthropological explanatory framework, it can be assumed that evolution occurred in a scenario in which human groups alternated periods of famine with periods of relative satiety. This situation, found in hunter-gatherer groups and which has been possible to study in the last century, resulted in the generation of the thrifty genotype hypothesis. This hypothesis is consistent with the explanatory framework of recent human evolution because it proposes that this genotype is useful for survival in conditions of food uncertainty.¹³

In a world changing radically in a short period, food began to be available in a stable and sometimes excessive way. In modern societies, civilization modified its environment drastically and in several ways, particularly in those societies that adopted a western lifestyle. The human being has maintained his biological inheritance without significant changes in the last 50,000 years. On the contrary, the environment did change substantially. Suddenly, access to food was permanent. Except for their endemic presence in some regions of the world and at specific moments in contemporary history, famines decreased significantly.¹³

The hypothesis of the thrifty genotype has not been without objection. Despite all the research done to explain the rapid increases of the obesity and diabetes prevalence in populations that recently introduced diets and the western cultural environment, the author found no conclusive evidence of glucose intolerance in the young tribal population.¹⁴⁻¹⁶ The original hypothesis suggested that as the periods of famine were very intense and prolonged, the thrifty genes might have been selected in the Paleolithic period. It was estimated that around 950 episodes of famine would have been required for a gene to be selected, which implies that all humans have thrifty genes if it is considered that 600 to 5,000 famines have occurred throughout history.^{17,18}

Faced with critique, in 1989, even Neel warned that "the data on which this hypothesis was based has now collapsed to a large extent, but the prevalence of the high predisposition should still be explained", "a series of specific genetic mechanisms are beginning to emerge, but none of these seem to have the potential for explaining the predisposition frequency so far".¹⁹ In a 1998 review of the hypothesis, Neel returned to his original idea, maintaining that diabetes is caused by thrifty genes that were selected as a result of intermittent periods of famine. Moreover, he tried to support his hypothesis of the prevalence of obesity and arterial hypertension, two other related diseases that share some of the epidemiological characteristics of diabetes, and are associated with the emergence of civilization. Both diseases occur in physiologically systems, which have adapted to an environment far from modernity and are brought to their functional limits by current environmental changes. These changes have a gradual onset and are related to family components, which points to a complex interaction of genetic and environmental factors.¹⁹

Criticism did not only arise in the academic world. The social implications derived from the context in

which these studies were carried out caused various ideological aspects to permeate and misconstrue the main contributions obtained by this interdisciplinary group of researchers.

Biological and social determinism and the lack of individuality

The thrifty genotype concept maintains a broad explanatory capacity in the context of evolution. However, it also supports a reductionist theoretical basis on which the primary way of understanding the epidemic of obesity in the world rests. This hypothesis, reliable for its logical and empirical coherence, provides a genetic and anthropological basis that allows understanding the mechanisms through which the body favors the storage of energy reserves in food-restricted environments. This interpretation has different implications since it strengthens the deterministic point of view, which assumes that people are passive victims of their biological nature and have a petty or at least a secondary responsibility in the explanation of their behavior. In this sense, the thrifty genotype, which represented an adaptive advantage for the human species, has become a disadvantage due to the sudden modification of the environment produced by globalization and the inability of people to adapt their behavior to this environment.

At present, it is known that obesity is an epidemic with multifactorial roots. To understand its origin, prevention, and treatment, both biological and social determinism have been incorporated into its analysis. Firstly, in the academic context of life sciences, the explanation based on the biological determinism prevails: the epidemic has arisen because the affected individuals have a genetic predisposition that inevitably leads them to gain weight. From this perspective, the biology of people can explain why some individuals store more energy reserves than others. For example, those individuals affected have inherited not enough mechanisms for satiety, have higher insulin resistance, and some biochemical mediators, such as adiponectin, are altered either at their blood levels or molecular structure. Consequently, given these inherited characteristics, Mexicans, among other groups such as the Pima Indians, will have a particular predisposition to suffer from this disorder.

Secondly, considering an approach based on social health determinants as well as on the framework of social determinism, weight is increased because people live in a pressing, stressing, and overwhelming environment. In

this approach, the environment almost forces people to have a higher intake of poor-quality food and also provides fewer opportunities to perform physical activities due to factors such as working conditions, insecurity, or lack of recreational spaces. The power of advertising of food-producing companies, a distorted market, demanding access to education, poverty, among other factors, are social determinants that inevitably lead to the emergence of this epidemic.

Determinism is the philosophical current that affirms that causal relationships are defined *a priori*: whether human biological constitution or society are proposed as the factors that cause our behavior, the effect will be the same. In this view, human behavior will originate automatically and unidirectional because of these causes. The role of the individual and the possibility of exercising autonomous decisions would seem irrelevant.²⁰

The debate between determinism, fate, and free will has a long tradition. Even though Ian Hacking suggests that “the most important conceptual event of twentieth-century physics was the discovery that the world is not subject to determinism,” in the sciences related to human biology, determinism maintains one of its strongest bastions. Even for some philosophers, such as Ernst Cassirer, the origin of determinism can be identified in biology; specifically, in a speech delivered in 1872 by Emil Du Bois-Reymond, a prominent neurophysiologist.²⁰

The deterministic doctrine allows elaborating arguments that explain the development of overweight and obesity as an inevitable consequence of a genotype and an operating and inertial manifestation of the environment throughout our life. This vision allows individuals to avoid their responsibility and commitment to their health. In this sense, the deterministic doctrine echoes, in the words of Shakespeare, the poignant lament of Romeo: “Oh, I am fortune’s fool!”²¹

Freedom and individual responsibility as definitive alternative solutions

The present research group argues that the explanation for the emergence of the pandemic overweight and obesity based on biological and social determinism is insufficient as it excludes the role of individual responsibility. Kant states that every person has free will, and therefore, is responsible. Hence, by being responsible for themselves, people will assume a behavior relative to the way they feed and take care of their health.

The individual will indeed be driven to satisfy his elementary desires and preferences for his biological nature. It is also true that the social environment exerts an

influence based on the behavior of others. However, these influences will have an effect that will depend on the level of development (emotional, intellectual, and moral) achieved by the individual. Our thesis is that lower development facilitates more biological and environmental influence. In contrast, in subjects that reach higher degrees of intellectual and moral stature, and consequently, greater autonomy, the influence of biological or social factors will decrease proportionally. Therefore, focusing on the causes and solutions of this epidemic by factors outside the individual will only contribute to underestimating and undermining responsibility. This responsibility should be encouraged to have an organized society. From this perspective, the obesity epidemic cannot be understood, much less resolved, without considering the factors surrounding human individuality, its differential levels of development, and independent decision-making. The free will, according to Kant, is what determines or should ultimately determine the behavior.²²

Amartya Sen makes a distinction between individual and social responsibility, and argues that, as social influence increases, individual responsibility decreases; with this, we lose "motivation, participation, and self-knowledge." For Sen, it is unfortunate and counter-productive when this occurs because "there is nothing to replace individual responsibility," which comes from the exercise of freedom. "Responsibility demands freedom," and freedom is the possibility to choose between the opportunities that the State or other institutions can offer, or that derive from the various conditions that arise during life, but ultimately, freedom is always exercised in a strictly personal way.²³

In this environment and market that offers food in an excessive way to a hedonistic and prone to consumerism society, the mechanisms that promote a reflective, critical and rational individual development in an ethical atmosphere driving the Aristotelian ideal that says that "each individual must seek their self-development from their rational and moral potential" have not emerged yet. Determinism in any of its forms helps to hinder this effort and tends to perpetuate dependent, fragile, and morally meaningless societies. According to Aristotle, "health depends on the balance of living habits".²⁴ The definitive solution to the problem of obesity, as well as other social severe problems in the medium and long term, depends on policies that promote the development of social mechanisms that strengthen the individuals at a personal level.²⁵ Modern science does not contribute to producing definitive solutions to these health problems due to the philosophical and ideological positions that underlie its current practice.

The social goal should contribute to the development of "rational people", in accordance with Rawls' concept,²⁶ based on individuals who have intellectual and emotional maturity, solid education, self-management, wisdom decision making, internal harmonious life, a sufficient level of empathy towards others and a deep sense of responsibility for themselves and others. Such people will not be determined by their biological inheritance or by acquired habits, rules or beliefs, nor will they succumb to media influence. On the contrary, they will have the knowledge, moral values, and the indispensable tools to understand, prevent and avoid the dangers of an unfavorable environment.

Not only is it necessary to build a rational and efficient social contract that optimizes coexistence networks, but fundamentally it is necessary to develop social mechanisms that strengthen individuals at a personal level. The continuous search for satisfiers for elementary needs, the lack of high endeavor purposes, low personal discipline, low self-esteem, insufficient educational levels and, overall, a generalized failure to promote and achieve ideals of individual development, except in small sporadic and isolated successes throughout history, have contributed to forming people with developmental severe limitations or with severe distortions in their personal growth, which is usually associated with a deep-rooted and prevalent cynicism.

It is necessary to recognize that this is a long-term and challenging solution. Moreover, it is based on high-quality education, improvement in living standards and a reorientation of social objectives. The problem is that such a solution is not among the purposes of our community. The conceptual platforms on which most of the strategies that have been proposed are based not only do not contemplate proper strengthening but go in the opposite direction. Unfortunately, in the academic environment, the current approach remains one of biological reductionism, while in public health policy, it is social determinism.

Medical sciences need to incorporate the concepts of freedom and responsibility at the individual level as study variables. These instruments should achieve scientific legitimacy, which has not happened due to the ideological implications associated with biological and social reductionism. Freedom and responsibility are variables of difficult technical approach, although they cannot be eluded any longer due to the meaning of human life. The biological, statistical and social study of average people is methodologically more accessible, but its value for the explanation of human existence is clearly insufficient.

Eugenics is a social philosophy that represents a latent risk in our times, a danger that will inevitably increase in the present century. The possibilities of genotype manipulation increase day by day and will constitute a permanent temptation, whose consequences could alter the very meaning of human nature. The hectic search for genomic or molecular alterations currently observed among scientific communities around the world will be useful for explanatory but not instrumental purposes. In other words, the biological basis and mechanisms from which health and behavioral disorders are presented will be better understood, but practical solutions that free individuals from their responsibilities will not arise. The responsibility of taking charge of their own lives and to fully assume the consequences their personal decisions will endure. The thrifty genotype is a hypothesis that enables remembering the fundamental and essential meditation on the role and the limitations of our biological constitution as a substantive and sufficient element in the conformation of our human nature.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

Conflicts of interest

The authors declare that they have no conflicts of interest.

References

1. World Health Organization [Internet]. Obesidad y sobrepeso. Mexico; 2014.
2. Kelly T, Yang W, Chen CS, Reynolds K, He J. Global burden of obesity in 2005 and projections to 2030. *Int J Obes (Lond)*. 2008;32:1431-7.
3. Instituto Nacional de Salud Pública. Encuesta Nacional de Salud y Nutrición 2012: Resultados Nacionales. Adultos. Sobrepeso y obesidad. Cuernavaca, Morelos, Mexico: Instituto Nacional de Salud Pública; 2012. 180-6.
4. Instituto Nacional de Salud Pública. Encuesta Nacional de Salud y Nutrición 2012: Resultados Nacionales. Niños. Sobrepeso y obesidad. Cuernavaca, Morelos, Mexico: Instituto Nacional de Salud Pública; 2012. 149-51.
5. Instituto Nacional de Salud Pública. Encuesta Nacional de Salud y Nutrición 2012: Resultados Nacionales. Adolescentes. Sobrepeso y obesidad. Cuernavaca, Morelos, Mexico: Instituto Nacional de Salud Pública; 2012. 167-70.
6. Hume DW. Anthropological Niche of Douglas W. Hume. Manuscript Collection No. 89. The Papers of James V. Neel; 2012. Available from: http://anthroniche.com/darkness_documents/0056.htm.
7. Salzano FM, James V. Neel and Latin America—or how scientific collaboration should be conducted. *Genet Mol Biol*. 2000;23:557-61.
8. Weiss KM, Ward RH, James V. Neel, M.D., Ph.D. (March 22, 1915–January 31, 2000): Founder Effect. *Am J Hum Genet*. 2000;66:755-60.
9. Chagnon NA. Noble savages. My life among two dangerous tribes—The Yanomamo and the anthropologists. New York: Simon & Schuster; 2013.
10. Neel JV. Diabetes mellitus: a “thrifty” genotype rendered detrimental by “progress”? *Am J Hum Genet*. 1962;14:353-62.
11. Arvelo Jiménez N. La saga de los Yanomamo. Reflexiones en torno al libro *Darkness in El Dorado*. *Interciencia*. 2001;26:32-8.
12. Chacín M, Bermudez V, Rojas Quintero JJ, Núñez PM, Añez R. Predisposición humana a la obesidad, síndrome metabólico y diabetes: el genotipo ahorrador y la incorporación al genoma humano desde la antropología biológica. *Diabet Int*. 2012;3:11-23.
13. Diamond J. The world until yesterday. What can we learn from traditional societies? New York: Penguin Group; 2012.
14. Lindsay R, Bennett P. Type 2 diabetes, the thrifty phenotype—an overview. *Br Med Bull*. 2001;60:21-32.
15. Neel JV. The Thrifty Genotype Revisited. In: *The genetics of diabetes mellitus*. New York: Academic Press; 1982.
16. Spielman R, Fajans SS, Neel JV, Pek S, Floyd JC, Oliver WJ. Glucose tolerance in two unacculturated Indian tribes of Brazil. *Diabetologia*. 1982;23:90-3.
17. Cohen M. Health and the rise of civilization. New Haven: Yale University Press; 1989.
18. Neel JV. The study of natural selection in primitive and civilized human populations. *Hum Biol*. 1989;61:811-23.
19. Neel JV. The “thrifty genotype” in 1998. *Nutr Rev*. 1989;57:S2-9.
20. Hacking I. La domesticación del azar. Barcelona: Editorial Gedisa; 1990.
21. Shakespeare W. *Romeo and Juliet*. New York: Penguin Group; 1982.
22. Copleston F. Historia de la filosofía. Volumen 3. De la filosofía Kantiana al Idealismo. Barcelona: Ariel; 2011.
23. Sen A. Development as freedom. New York: Anchor Books; 1999.
24. Jaeger W. Aristóteles. Bases para la historia de su desarrollo intelectual. Mexico: Fondo de Cultura Económica; 1984.
25. Wolff J. An introduction to political philosophy. New York: Oxford University Press, Inc.; 2001.
26. Hauser MD. Moral minds, the nature of right and wrong. New York: Ecco; 2007.