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EVOLUTION, BLOOD TYPES, AND WEIGHT LOSS: A CRITICAL EXAMINATION OF A POPULAR DIET

GREGORY W. THIEMANN

*Department of Biology, Dalhousie University,
Halifax, Nova Scotia, Canada B3H 4J1*

Email: thiemann@dal.ca

In a best-selling diet book D'Adamo & Whitney (1996) claim that an individual's ABO blood type is the single most important factor in determining the appropriate diet for weight-loss and general health. This is based on the premise that the four different blood types have evolved within the past 50,000 years and that each type is an adaptation to a particular lifestyle and diet. While each of the four recommended diets, if followed for an extended period, would likely produce weight-loss in people suffering from obesity, modern genetic research indicates that the human ABO blood groups evolved millions of years ago and pre-date the existence of *Homo sapiens*. With no clinical evidence or theoretical basis to support them, the claims for the supposed curative functions of D'Adamo & Whitney's Blood Type Diet are misleading and potentially dangerous.

Dans leur livre de régime à succès, D'Adamo et Whitney (1996) allèguent que c'est le groupe sanguin d'une personne qui est le facteur le plus important dans le choix d'un régime approprié pour maigrir et rester en santé. Cette affirmation est basée sur l'hypothèse que les quatre groupes sanguins ont évolué au cours des 50 000 dernières années et que chacun résulte d'une adaptation à un style de vie et à un régime particuliers. Les quatre régimes recommandés, s'ils étaient suivis pendant une période prolongée, seraient certes de nature à faire maigrir les personnes qui souffrent d'obésité, mais les recherches en génétiques actuelles indiquent que les groupes sanguins humains ont évolués depuis des millions d'années et remontent même avant l'existence de l'*Homo sapiens*. En l'absence de preuve clinique ou de fondement théorique pour les appuyer, les allégations relatives aux soi-disant fonctions curatives des régimes de D'Adamo et Whitney basés sur le groupe sanguin sont trompeuses et peuvent même s'avérer dangereuses.

INTRODUCTION

Diet book publishing has become a multi-billion dollar industry, with successful titles spending more than six years on the New York Times bestseller list. At the same time, obesity has reached epidemic proportions in North America, affecting 27% of the U.S. population, with an additional 34% considered overweight (Wyatt 2003). Although obesity in Canada is less widespread (approximately 15% in 1998) it more than doubled from 1985 to 1998 (Katzmarzyk 2002). The health implications of epidemic obesity are serious, leading to increased rates of diabetes,

heart disease, and 280,000 deaths each year in the United States alone (Allison et al. 1999). With promises of miraculous weight-loss and renewed vitality, diet books have become extremely popular in a North American society struggling to lose weight.

One of the best-selling diet books is 'Eat Right 4 Your Type: The Individualized Diet Solution to Staying Healthy, Living Longer and Achieving Your Ideal Weight' by D'Adamo & Whitney (1996). In it the authors claim that each blood type (A, B, O, or AB) is an adaptation to a particular lifestyle and diet. A person's blood type determines what they should eat, how they should exercise, their susceptibility to illness, and how they react to stress. D'Adamo & Whitney assert that "*your blood type is the key that unlocks the door to the mysteries of health, disease, longevity, physical vitality, and emotional strength*". 'Eat Right 4 Your Type' is the first volume in a 16 book series; among the most recent titles are 'Cancer: Fight it with the Blood Type Diet' (D'Adamo & Whitney 2004) and 'Diabetes: Fight it with the Blood Type Diet' (D'Adamo & Whitney 2005). With such ambitious claims, a detailed examination of the theory behind these books is both appropriate and necessary.

THE BLOOD TYPE DIET THEORY

According to 'Eat Right 4 Your Type', the human blood types evolved in response to changes in the ancient human habitat and diet. Consequently, each type is perfectly suited to the particular diet most common at the time and place the blood type emerged. The book asserts that the ABO blood types appeared sequentially as humans evolved and dispersed across the globe. Type O appeared in the earliest humans in Africa about 50,000 years ago; Type A appeared as humans moved away from hunter-gatherer lifestyles and towards agrarian society (15,000-25,000 years ago); Type B evolved as humans migrated into colder environments in Europe, Asia, and the Americas (10,000-15,000 years ago); and Type AB was the product of interbreeding between populations of Type As and Bs (about 1000 years ago).

According to 'Eat Right 4 Your Type', Cro-Magnons of 40,000 B.C. were skilled hunters who relied on animal protein for their nutritional requirements. While the authors refer to these early peoples as hunter-gatherers, they indicate that Cro-Magnons relied solely on meat and their Type O blood was specialized for digesting animal protein; however, it should be noted that the authors fail to explain how blood types can modify digestion. Apparently, these early humans occupied the top of their African food chain and their population eventually "exploded". Within 10,000 years, competition for limited food resources became intense and people started fighting for territory; "*as always, human beings found their greatest enemy to be themselves*". Around 30,000 B.C., as a result of this intense resource competition, people began to

migrate out of Africa to Europe and Asia. People were as gluttonous in these areas as they were in Africa, and by about 20,000 B.C. the vast herds of large animals in these new lands had been decimated. It was apparently at this point that humans finally began to utilize plants as food: *“it is likely that the carnivorous humans quickly became omnivorous, with a mixed diet of berries, grubs, nuts, roots, and small mammals”*. The northward migration of early humans also *“created lighter skins, less massive bone structures, and straighter hair”* than in the African population. Eventually, the Cro-Magnons overpopulated their northern hunting grounds as well and either went extinct or migrated further to the Americas.

Considering this evolutionary backdrop, D’Adamo & Whitney (1996) instruct modern Type Os to also consume a meat-based diet. *“Eat beef, lamb, turkey, chicken or the recommended fish as often as you wish. The more stressful your job or demanding your exercise program, the higher the grade of protein you should eat”*. Unfortunately, the meaning of “grade of protein” is not explained. D’Adamo & Whitney do recommend that Type Os try to limit portion sizes—not to aid digestion or avoid heart disease, but because *“our ancestors didn’t feast on sixteen-ounce steaks; meat was too precious and scarce for that”*. However, this seems entirely inconsistent as large portion size was likely a common characteristic of early meat-based diets. The concept of food storage depended on the development of agriculture and animals killed by Cro-Magnons therefore had to be consumed more or less immediately or left to rot.

In addition to a high-protein, high-fat, high-calorie diet, Type Os should avoid cereals, breads, grains, pasta, dairy products, and even many vegetables such as cabbage, corn, and brussels sprouts. Surprisingly, even condiments, spices, and beverages should be carefully considered. For instance, mustard is fine, but ketchup is harmful to Type Os. Cayenne pepper is also good, but black pepper should be avoided. Beer and wine is acceptable, but Type Os should stay away from tea and soft drinks.

‘Eat Right 4 Your Type’ also recommends evolutionarily-compatible exercises. Type Os *“have the immediate and physical response of our hunter ancestors,”* and *“are meant to release the built-up hormonal forces through vigorous and intense physical exercise”*. D’Adamo & Whitney (1996) therefore recommend one or more of the following activities, three to four times per week: aerobics, swimming, jogging, stair climbing, martial arts, and contact sports.

Evidently, Type Os tend to be *“strong, certain, and powerful—blushing with good health and optimism”*. D’Adamo & Whitney (1996) cite Ronald Regan as a stereotypical Type O: *“His administration was characterized by a surety, evenness, and an unflagging optimism about the future”*. Other notable Type Os include, Al Capone, Mikhail

Gorbachev, Queen Elizabeth II, and disgraced sports commentator Jimmy "The Greek" Snyder.

Blood group A apparently emerged with the rise of agriculture and permanent farming communities in Asia and the Middle-East, later migrating into western Europe. With their largely vegetable-based diets, the Type A mutation allowed Neolithic people *"to better tolerate and absorb cultivated grains and other agricultural products"*. With the rise of permanent human settlements, *"planning and networking became the order of the day. Psychologically, these are the traits at which Type As excel"*. D'Adamo & Whitney (1996) claim that the Type A phenotype quickly spread through the farming population. *"What could have been the reason for this extraordinary rate of human mutation from Type O to Type A? It was survival. Survival of the fittest in a crowded society. Because Type A emerged as more resistant to infections common to densely populated areas, urban, industrialized societies quickly became Type A"*. Here, the authors have not only seriously confused the concepts of genetic mutation and natural selection, but also suggested that the industrial revolution played a role in evolutionary changes that presumably occurred 20,000 years ago.

'Eat Right 4 Your Type' recommends a vegetarian, low-fat, low-calorie diet for Type As. They should avoid meat, dairy, most wheat and fish, and some fruits and vegetables, including bananas, oranges, cabbage, eggplant, and lima beans. In addition to these severe dietary restrictions, the unfortunate Type A is also predisposed to heart disease, cancer, and diabetes. The Type A exercise program involves soothing and non-strenuous exercises such as tai-chi, yoga, and golf. These activities presumably help Type As calm down since they *"tend to have more tightly wired systems. They bottle up their anxiety...but when they explode, watch out."* Also, *"Type As are poorly suited for the intense, highly pressured leadership positions at which Type Os excel...[w]hen Type As get into these positions, they tend to unravel"*. Perhaps not surprisingly then, the list of notable Type As is substantially less admirable than Type O; Lyndon B. Johnson, Richard Nixon, Jimmy Carter, and Adolph Hitler round out the list. D'Adamo & Whitney (1996) even contend that Hitler's actions were consistent with *"a mutated Type A personality"*.

The remaining two diets are along the same lines as the first two. Briefly, the book claims blood Type B evolved independently of Type A 10,000-15,000 years ago in what is now Pakistan and India. In the cold Himalayan environment, *"blood Type B may have initially mutated in response to climactic [sic] changes"*. Type Bs have a tolerant digestive system and should eat a balanced, nutritious diet. They have strong immune systems, should engage in lots of medium intensity exercise, and tend to have creative and well-balanced personalities.

Blood group AB apparently emerged about 1000 years ago as a result of interbreeding between Type A Europeans and Type B

"barbarian hordes" from Asia. While it seems odd that Type AB didn't emerge until very recently despite the coexistence of Types A and B for at least 10,000 years, D'Adamo & Whitney (1996) base their timeline on the fact that "*prehistoric graves in Hungary show a distinct lack of this blood group*". It would be interesting to know precisely how many graves were examined considering that blood group AB is quite rare in the modern human population; i.e., only 3% of Canadians are Type AB (Canadian Blood Services 2004).

The Type AB diet is the most complicated and arbitrary of the four, with seemingly random contributions from both the A and B programs. People with AB blood should engage in similar exercise as Type As (non-strenuous) but "*are often stronger and more active than the more sedentary Type As*". Type ABs tend to be charming, popular, spiritual, but "*somewhat flaky*" and evidently have exceptionally weak immune systems. Some famous Type ABs include John F. Kennedy, Marilyn Monroe, and apparently Benedict Arnold. Unfortunately, no information is provided as to how Arnold's blood type was determined; he died exactly 100 years before the ABO classification system was devised.

DOES THE BLOOD TYPE DIET WORK?

The reasoning behind the Blood Type Diet is clearly a creative, if somewhat rambling story. The diets themselves are enthusiastically defended by followers who swear that the system "works." It seems likely that any of the four diets, if maintained over an extended period, would encourage weight-loss, since each one prescribes reasonable portion sizes and lots of exercise.

Close to 90% of the North American population would be instructed to follow either the Type O or the Type A diet. The Type O plan is the kind of low-carbohydrate diet that Samaha et al. (2003) showed could result in weight loss of about 5 kg over a six-month period in severely obese people. The authors, however, also noted a dropout rate of 47%. The Type A diet is simply a low-calorie, vegetarian diet and if anyone following it could also manage the recommended five sessions of aerobics each week, weight-loss would also be likely. While a strategy of controlled caloric intake and regular exercise is the only reasonable weight-loss strategy, the evolutionary theory upon which the Blood Type Diet is based is seriously flawed.

Blood Type Biology and Evolution

The ABO blood groups were discovered in 1901 by Nobel laureate Karl Landsteiner. Humans and other primates can be typed according to the ABO system: Type A blood contains red blood cells (RBCs) with the A antigen (a protein) on their surfaces, Type B cells have the B antigen,

Type AB cells have both A and B antigens, and Type O RBCs have neither. In addition, blood contains antibodies opposite to the existing antigens (i.e., Type A blood contains anti-B antibodies, Type B blood contains anti-A antibodies, Type O blood has both kinds of antibodies, and Type AB has neither). ABO blood type is controlled by alleles at a single gene locus on chromosome 9.

The entire Blood Type Diet theory rests on the idea that the two blood type antigens (A and B) and the four different phenotypes evolved sequentially in the human population over a period of about 50,000 years. The authors claim that in this way, each blood type became perfectly adapted to the dominant diet at the time of its emergence. However, it is important to note that blood cells contain hundreds of other antigens in addition to A and B and more than 20 other blood typing systems have been developed (see Garratty et al. 2000). Why the ABO classification system should hold such a special place in our evolutionary history is not addressed in 'Eat Right 4 Your Type'.

If diet and blood chemistry were as tightly coupled as D'Adamo & Whitney (1996) claim, and considering the enormous regional and cultural variation in human diets, one could reasonably expect far more than four blood phenotypes to emerge. Furthermore, species with more narrow and specialized diets should be expected to have fewer blood types, although this does not seem to be the case. Wild cats are obligate carnivores and show three different blood types (A, B, and AB; see Griot-Wenk & Giger 1999) while horses have 14 different blood group phenotypes and a strictly herbivorous diet (Dobrev et al. 1972).

D'Adamo & Whitney (1996) have based their unique theory of human evolution on the modern geographic distribution of blood types. The A allele is most common in Europe and the Near-East, the B allele is most common in southern and central Asia, and (within the Old World) Type O is most common in Africa (Mourant et al. 1976). These correspond to the areas where 'Eat Right 4 Your Type' claims the three blood types originated.

D'Adamo & Whitney (1996) also confuse correlation with causation when speculating that the development of agriculture resulted in the evolution of blood type A. While there is a relatively high frequency of Type A in the same general region of the Near-East where agriculture originated (Renfrew 1973, Diamond 1999), there is no evidence to suggest that this is the time or place where humans first utilized plant material or where blood type A emerged. To the contrary, an overwhelming body of evidence indicates both omnivory and the ABO blood types pre-date agriculture by millions of years.

D'Adamo & Whitney's (1996) theory ignores the fact that the evolutionary ancestors of all modern primates were forest-dwelling creatures that fed on insects as well as fruits, nuts, berries, and other plant material (Morris 1967). Our ape ancestors depended on vegetation long before they came down from the trees and learned to hunt. The

dentition of modern primates reflects this omnivorous past, with pointed canines and sharp incisors suitable for tearing meat, combined with flat, grinding molars and thick enamel for crushing tough plant cell walls (e.g. Shellis et al. 1998). In fact, plant material comprises 87-99% of the annual diet of all great apes (Milton 2003). In our more recent past, the fossil record indicates the closest direct ancestors of *Homo* spp. (*Australopithecus* sp.) were also omnivores, roughly two to four million years before agriculture (e.g. Robinson 1954, Wood & Strait 2004). D'Adamo & Whitney's assertion that humans were strict carnivores prior to the development of agriculture completely ignores the fossil record.

Recent genetic studies have provided a fascinating insight into blood type origins. A-like and B-like antigens are present in the blood of several non-human primates; A in chimpanzees, B in gorillas and siamangs, and both A and B in orangutans, gibbons, and New and Old World monkeys (O'hUigin et al. 1997 and references therein). The evolutionary relationship of human blood antigens to those of non-human primates has been the subject of recent debate. Martinko and his colleagues (Martinko et al. 1993) concluded that the A and B alleles were so similar in all primates that they must have come from a common ancestor. These authors estimated that the polymorphism responsible for the two alleles was at least 13 million years old. The various blood types therefore evolved before humans, chimps, or gorillas. In a separate study, Colm O'hUigin and his colleagues at the Max Planck Institute for Biology (O'hUigin et al. 1997) found that between primate species, the A, B, and O alleles were indeed very similar, but were more likely the result of convergent evolution, not a common ancestor. These authors estimated that the human blood type lineage emerged at least three million years ago. Whether the blood groups are the result of convergent or trans-species evolution, it is clear that they not only pre-date agriculture and urbanization, they pre-date the existence of *Homo* spp. (Wood & Collard 1999, Wood 2002).

How the Blood Type Diet is Supposed to Work

The Blood Type Diet offers a mechanism that is relatively vague and not easily examined in detail. D'Adamo & Whitney (1996) contend that food interacts with a person's blood via lectins—a broad class of proteins found in nearly every living organism and characterized simply by an ability to bind to carbohydrates. According to the Blood Type Diet, these proteins react to blood cells in a type-specific way and cause them to agglutinate, or clump together. Once ingested, different lectins apparently target specific organs and physiological systems and eventually lead to conditions as serious as schizophrenia, cancer, and strokes. In order to prevent this toxic agglutination, 'Eat Right 4 Your Type' instructs readers to avoid foods with lectins that are "incompatible" with their blood type. The incredible danger of food lectins is illustrated

with a description of ricin, “a toxic lectin extracted from castor beans” and a poison made infamous by a KGB assassin in 1978. (In a peculiar coincidence, ricin was also cited by the Bush administration as one of the “weapons of mass destruction” controlled by Saddam Hussein (CIA 2002)).

Research on lectins has revealed a remarkably diverse group of proteins (more than 100 have been isolated from legumes alone (Sharon & Lis 2002)) with correspondingly diverse biochemical properties. While some lectins potentially can agglutinate red blood cells, those found in most food items are inactivated by heating and only the raw, mature beans of the genus *Phaseolus* (e.g. lima bean, kidney bean, black bean) have sufficient levels of lectins to cause untoward reactions (Liener 1986, Sharon & Lis 1989, 2002). Even those lectins that cause blood cell agglutination are not necessarily harmful. In fact, the toxicity of ricin is caused by the inactivation of ribosomes, not RBC agglutination. The agglutination observed during early studies was not caused by the ricin lectin, but rather by another compound called RCA (*Ricinus communis* agglutinin), which is nontoxic (Olsnes et al. 1974, Rüdiger & Gabius 2002).

Origins of the Blood Type Diet

D’Adamo & Whitney (1996) claim that two pieces of evidence were instrumental in developing their diet theory. The first was the observation that peptic ulcers were more common in people with type O blood. The second piece of evidence was that both pernicious anemia and stomach cancer were more common in Type As. From these two observations, D’Adamo & Whitney conclude that “*there absolutely was a scientific basis*” for a blood type-based diet since there was a connection between blood type and gastric disease.

In making this conclusion, D’Adamo & Whitney (1996) again confuse correlation with causation. Just because stomach cancer is statistically more common in Type As than Type Os does not mean that Type A blood causes cancer, or that “incompatible” foods cause cancer. Furthermore, while real correlations may exist between ABO blood groups and certain diseases (e.g. Norwalk virus (Hutson et al. 2002)), the relationships cited by D’Adamo & Whitney are not well-supported by evidence.

Increased rates of pernicious anemia in Type As and peptic ulcers in Type Os were recorded in the mid-1950s (e.g. Buckwalter et al. 1956, Creger & Sortor 1956), but more recent studies failed to corroborate these findings (e.g. Callender et al. 1957). Carmel et al. (1981) found no relationship between blood type and pernicious anemia among African- and Latin-American patients, and questioned the accuracy of the apparent association between blood type A and gastric cancer. Further, the majority of peptic ulcers are now thought to be caused by the

bacterium *Helicobacter pylori* (or by extended use of non-steroidal anti-inflammatory drugs) and recent studies have shown no association between blood type and *H. pylori* infection or the incidence of peptic ulcers (e.g. Umlauft et al. 1996, Keller et al. 2002, Robertson et al. 2003).

While the book claims to be “an extension of the recent groundbreaking findings concerning human DNA”, it relies heavily on literature from the 1950s and 1960s. Although the book was originally published in 1996, only eight of the 103 cited references were published after 1990, and three of those eight were either authored or co-authored by D’Adamo himself. The book cites two notable papers by Wyman & Boyd (1935, 1937) regarding the evolution of blood types. These authors considered the rate of human genetic mutation and concluded that the ABO blood types were at least 750,000 years old—some 700,000 years older than D’Adamo and Whitney (1996) claim. Wyman & Boyd also concluded that for the B blood type to have evolved within the last 20,000-50,000 years, the human mutation rate would have to be so high that it would exceed the rate of mutation in *Drosophila*—an unrealistic assumption. D’Adamo & Whitney appear to have twisted the work of Wyman and Boyd to fit their hypothesis: “*The genetic mutation that produced Type A from Type O occurred rapidly—so rapidly that the rate of mutation was comparable to four times that of Drosophila, the common fruit fly and current record holder!*”

CONCLUSIONS

The four “individualized” diets offered in ‘Eat Right 4 Your Type’ all recommend limited caloric intake combined with lots of exercise. As a result, each one, if followed over an extended period, would probably promote weight-loss. Unfortunately, the severe and arbitrary food-choice restrictions likely make adherence to any of the diets exceedingly difficult. Despite this potential for weight-loss—and D’Adamo & Whitney’s (1996) assertions to the contrary—the Blood Type Diet theory has no basis in evolutionary biology, anthropology, or biochemistry.

One could argue that the theory behind any diet is less important than the results it produces. However, when any popular book claims to be based on “scientific research”, it must be challenged—not only to protect the non-scientific reader from dubious claims, but also to protect the credibility of real science. ‘Eat Right 4 Your Type’ not only offers easy answers for weight-loss, but also for disease therapy. D’Adamo & Whitney (1996) insist that the Blood Type Diet will not only *prevent* certain diseases (it is reasonable to suggest a vegetarian diet could reduce the risk of heart disease), it will also *cure* them. The last two chapters of the book are dedicated to case histories of “patients”, most of whom were apparently treated by D’Adamo alone, who were cured of

everything from arthritis and psoriasis to breast cancer and AIDS. With no clinical or theoretical evidence to support them, these claims are misleading and potentially dangerous to people suffering from serious illness.

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