# A Scientific Report on Cow's Milk, Health and Athletic Performance

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## Foreword

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Like many Olympians, I grew up rather ordinary. I had ordinary childhood interests and sustained myself on an ordinary Standard American Diet—which included cow's milk—and I never questioned it. I also enjoyed hot dogs, guzzled artificially flavored fruit snacks, and literally drank the Kool-Aid. There are many childhood foods we adults once considered healthy or at least benign, but looking back we wonder, "What were we thinking?" Cow's milk is one of those foods. I never questioned it. My parents didn't either. We all were led to believe it was healthy for humans. As I grew up, I began to think critically about everything I ate and drank. Who was it that made us believe cow's milk is perfectly healthy for human beings? Why did they tell us this story? As I unraveled the reality behind this mass-marketed false narrative, I learned that it was all woven by the profiteers—the milk industry.

As I traversed the halls of the United States Olympic Training centers in both Chula Vista and Colorado Springs, I found that the cafeterias were inundated with milk products, completely leaning into the narrative that cow's milk must be an essential fuel for athletes. Why wasn't anyone asking more questions about where this idea came from? Why weren't the United States Olympic Committee (USOC) dietitians acknowledging research paid for by the milk industry to discern what's healthy? Years later, I saw a milk commercial using a champion athlete's relationship with her mother to sell this product claiming that, "9 out of 10 Olympians grew up drinking milk." This suggestion that me drinking milk as a child had anything to do with me becoming an Olympian was absurd. I felt my hard work and dedication were slighted—that my childhood dairy consumption was responsible for my achievements, not my work ethic. There is no way a single food can replace all those years of training and sacrifice.

This report was born out of a deep desire to disseminate the truth using unbiased science. It was born out of the need to tell people what a healthy lifestyle can look like, free from chronic diseases exacerbated by consuming dairy foods. And it was born to create a deeper awareness of the world in which we live.

Let me be clear before you read further, this report is not without passion. Don't get me wrong, exceptional efforts have been invested to provide an unvarnished, scientifically sound, and fact-driven analysis by experts who excel in their fields of study. There are hundreds of citations embedded, all transparently listed and accessible for the reader to review in order to make their own judgment. But having studied and antagonized the dairy industry for years, I know all too well the counterclaims that will be made about this report. The industry will claim I'm nothing more than an activist with an agenda and that any scientific facts contained here should therefore be ignored. And here's the truth—at least part of that is right. My agenda has not waivered for decades and that is to share and honor the whole, unvarnished truth that Big Dairy doesn't want you to know.

Right now, athletes are only given information that benefits the industry, not their performance. I readily welcome the dairy industry to challenge any finding published here and participate in an open public debate about the facts. I embrace my passion because I believe this knowledge will lead to a higher caliber of performance and longer careers for those who truly love their sport.

What you are about to uncover in this report are the negative health effects of dairy, the government involvement in milk marketing, and how the dairy industry manipulates its studies to favor cow's milk. You are about to learn that cow's milk increases the risk of breast cancer, that stuffed crust pizza was funded into existence by the government, and that industry studies on chocolate milk compare the nutritive value of the beverage to water in order to skew marketability. Who knew all of that hid behind the painted milk mustache?

Alvin Toffler once said, "We must adapt, question, and look with a naïve eye on the possibility of why something is or isn't." For too long, we have accepted cow's milk as a beverage that is healthful, a beverage that will nourish the bodies of adults and children. This report questions Big Dairy's dominance and offers solutions to adapt to a world without cow's milk—a world that is kinder, more sustainable, and healthier for all.

## Introduction

For over a century, cow's milk has been touted as a healthy part of a balanced diet. Celebrity athletes pose sporting milk mustaches. Chocolate milk is promoted as an exercise recovery beverage. And the idea that milk builds strong bones and muscles is best exemplified by the advertising campaign; "Milk does a body good." All very effective marketing, but is it good science?

This report shows that cow's milk has serious negative effects on general health and is an underlying factor in numerous chronic diseases. Dairy is a specific impediment to athletic performance and professional athletes' health. And dairy is the most heavily marketed and subsidized food group in the United States Department of Agriculture (USDA) and the Department of Human Health and Services' (HHS) Dietary Guidelines for Americans—the de facto standard for school lunches and a host of other regulated food regimens.[1] All this despite the fact that 36 percent of Americans are lactose-intolerant, with a much higher incidence among African Americans and other non-white minorities.[2]

*A Scientific Report on Cow's Milk, Health and Athletic Performance* unpacks all this and more. Based on rigorously cited essays by physicians, dietitians, and other health and nutrition experts, the report draws on a deep and growing body of independent, peer-reviewed evidence about the negative effects of dairy consumption.

The report exposes Big Dairy's flawed research—for instance, chocolate milk was compared to water when tested as a recovery beverage, rather than a nutrient-equivalent beverage.[3] The report highlights the billions of dollars spent by the US government to prop up Big Dairy and promote its products—despite the growing body of negative evidence.[4]

Finally, the report outlines an alternative, dairy-free diet, designed to help both professional and recreational athletes fuel for optimum performance and long-term health (see *Resources page 44*).

### *Key topics in the report:*

- Associations between dairy consumption and chronic disease.
- Dairy's negative effect on athletic performance.
- History of dairy marketing tactics, exploiting and targeting athletes.
- How dairy disproportionately sickens people of color.
- Cozy relationships between the US government and the dairy industry.
- Optimum dairy-free nutrition for athletes.

This report challenges the conventional wisdom that cow's milk is healthy for humans. The report seeks to educate and empower all of us—athletes included—to take back control of our nutrition, exceed our performance goals, and maximize our capacity for a long, healthy life.

Athletes are always striving to improve. But physical training is limited without the proper fuel. Dozens of professional and Olympic athletes—from Kyrie Irving to Alex Morgan— have leveled up their performance and extended the longevity of their careers by changing their diet. Eliminating dairy was the common denominator.

Athletes can do better. We can all live healthier lives. Success starts with ditching dairy.

# The Ubiquity of Cow's Milk in Sports

## A Historical Perspective on Cow's Milk and Athletes

Drinking cow's milk is a learned behavior, and this now habitual practice has been hardwired into our culture for over a century. However, the reason the dairy industry is pushing its products is not for health benefits as we have been taught to believe, but to save itself from drowning in its own chronic surplus. America's overabundance of cow's milk began after WWI due to overproduction during wartime.[1] Instead of allowing the industry to adapt to the natural economic changes, the government bolstered the dairy industry in a relationship that has become progressively more complicit and financially burdensome.[2] American consumers' understanding of cow's milk is based on nearly 100 years of government-funded marketing and lobbying from the dairy industry, coupled with professional athlete sponsorship and industry-funded research. While dairy does little to nurture the human body, the product has effectively raised the American public to suckle at its teat under the guise of health and athletic prowess.

Facing significant pressure from dairy farmers as milk prices plummeted throughout the 1930s, the US government launched its first major dairy assistance program in 1940—the Federal Milk Program for Schools.[3] This hyper-local subsidized school lunch program in Chicago was followed by a larger, more widespread program—the National School Lunch Program—brought into effect by the National School Lunch Act of 1946.[4] All public and private schools have the option to participate in this subsidized school lunch program under which it is mandatory to include a half pint of milk in each meal in order for the school to receive reimbursement.[5] To this day, children who participate in the National School Lunch Program—which offers lunches to students of low-income families at a reduced price or free—are required to take a carton of cow's milk unless a physician's note is provided.[5] In fact, "Milk is the only individual commodity that the program specifically requires schools to include in all reimbursable lunches," according to USDA's Economic Research Service. In 2008, nearly 60 percent of American children ages 5-18 participated in the program at least once per week.[4]

The advent of taxpayer-funded dairy advertising began just before these subsidized programs. Under the Works Progress Administration, the government subsidized the creation of posters promoting cow's milk beginning in 1935.[6] Despite the continued support of government-funded marketing, milk sales were still below the rate of supply, and in 1977, President Jimmy Carter allowed $2 billion federal dollars to be funneled into the dairy industry over the course of four years.[7] Instinctively, dairy farmers ramped up production to take advantage of this government subsidy, which resulted in yet a greater surplus.[7] This soon-to-rot milk was homogenized into "government cheese" and held in vast underground storage units across 35 states.[7] Not only was this move unproductive, but it was also expensive. In 1982, a *New York Times* reporter projected that the federal government would spend $40 to $50 million transporting this surplus dairy, and another $40 to $50 million storing it.[8] By this time, the government was spending $2 billion in taxpayer funds annually to support the dairy subsidy.[8] The solution was twofold: give the soon to-be moldy cheese to low-income citizens and funnel money into heavy dairy marketing.

This need for persistent promotion of surplus milk—along with continued pressure from the dairy industry—led to an initiative called the National Dairy Promotion and Research Board (also known as the Dairy Checkoff Program) in 1983[9] which continues to influence consumer attitudes toward dairy today. The organization's purpose is to promote dairy products by way of mass marketing and "nutrition education."[9] To fund this effort, dairy farmers pay a small fee based on the weight of the milk they sell.[9] This program is responsible for some of America's most craveable—yet least nutritious—food products including Pizza Hut's Stuffed Crust Pizza and Taco Bell's Quesalupa and succeeding Quesarito. The Board has worked with dozens of companies to promote dairy-heavy menu items—the result being 40 percent more cheese on Domino's pizzas,[10] more milky drinks at Starbucks,[11] and larger cheese slices on Egg McMuffins.[12] All of these decisions are overseen by Dairy Management Inc. (DMI)[10–12]—an umbrella organization that manages the National Dairy Council and the American Dairy Association—in conjunction with the USDA.

Dairy Management, Inc. is also responsible for promoting milk sales within schools, thus creating future consumers.[13] To accomplish this, DMI works with regional dairy associations to implement campaigns region-wide.[13] High school athletes are the main target. Under the Refuel with Chocolate Milk campaign, chocolate milk has become the official sponsor of public-school athletic associations across the country. For example, the American Dairy Association North East sponsors the public school athletic programs in four states (in addition to Washington, D.C.), providing over 50,000 young athletes with chocolate milk and thousands of coaches and athletic directors with dairy-based nutrition information.[13] By simply going to practice, these students are subjected to biased nutrition education, funded by the dairy industry.

In addition to these corporate initiatives, the checkoff program also launched an aggressive marketing component. Coined the Milk Processor Education Program (MilkPEP), this organization is responsible for the pro-dairy slogans we can never forget—Got Milk?, Milk Does a Body Good, and Built With Chocolate Milk, to name a few. With $112.7 million in assets in 2015, these campaigns do not lack funding.[14] Specifically, the Built With Chocolate Milk campaign has paid its way to become the official beverage of respected competition brands including Ironman, Rock n Roll Marathon Series, and USA Swimming, among others.[15] This campaign has also financially invested in over 100 elite and professional athletes who are compensated to promote milk.

This association with elite performance is a century-old strategy deployed by marketers across a range of industries. Since the 1920s, one could find posters featuring athletic endorsements of everything from Coca-Cola to Bull Durham Tobacco to milk.[16] Milk advertisements initially featured white male athletes to promote a sense of health, vitality, masculinity, and strong moral value, but as demands for diversity increased, female athletes (and a small selection of athletes of color) were incorporated into these promotions.[16] Today, milk is ubiquitous within the world of sport. MilkPEP signed a five-year sponsorship deal with the US Olympic Committee in 2016, and while postponed, the 2020 Olympic Games was secured by a $3 billion joint sponsorship between Coca-Cola and Mengniu Dairy, a Chinese milk company.[17] Individual athletes—from 2017 US Open tennis champion Sloane Stephens to Olympic hockey player Zach Parise[18]—were also part of MilkPEP's $93,400,000 2018 budget.[19]

The notion that chocolate milk is a recovery food is an industry-created illusion. Many of the studies that demonstrate a beneficial effect between athletic performance and chocolate milk are funded—at least in part—by the dairy industry and are specifically designed to favor dairy. Scientists ensure the industry's desired results by comparing chocolate milk to irrelevant controls such as water or nutritionally deficient sports drinks.[20]

Putting dairy-funded studies aside, evidence for milk as a performance beverage is insufficient.[21,22] Its reputation as a recovery beverage is widespread, but it is merely the result of million-dollar marketing which perpetuates the idea of cow's milk as a health food. The dairy industry funnels its resources into messaging and its sponsored athletes implying an association between cow's milk and athletic prowess, but consumers deserve to know the truth. It is the aim of this report to provide transparency regarding what the industry is actively trying to conceal.

## Chocolate Milk: The Ultimate Recovery Beverage?

Before we discuss the efficacy of chocolate milk as a fuel for exercise performance and recovery, we must look into milk's biological purpose. Milk is a growth-promoting substance, secreted by mammalian mothers who have recently given birth. As the sole source of calories for a newborn animal, milk contains all that is required to support their growth. The milk of a given species is unique to its own kind, specially adapted over millennia to fit the needs of that particular species.

Different animals develop in diverse ways and at varying rates. Differences such as dietary requirements, newborn growth rates, and general demands of life inform the makeup of a mother's milk. We see great variation in nutrient content between mammalian milks which reflects the vastly disparate growth requirements among species.

Cow's milk products are a staple food for the majority of Americans, yet few pause to question what it is that they are consuming. So, what is cow's milk? What does it contain, how does it differ from human breast milk, and is it an appropriate food for human beings—infant, child, adult, or athlete?

When a Holstein dairy calf—the most common dairy breed in the U.S.— is born, she will weigh an average of 100 lbs.[1] Under common conditions, she will double this birthweight in three months or less.[1] Holsteins reach a median weight of 682 pounds at 12 months and may ultimately grow to a full size of 1,500 pounds.[1]

Cow's milk is responsible for initiating the growth of a 100-pound calf into an over 1,000-pound animal. The nutrient composition of cow's milk is indicative of this. Whole cow's milk is composed of roughly 22 percent protein, 48 percent fat, and 30 percent carbohydrate by calories.[2] It also contains select vitamins and minerals—most famously, calcium.[2] In comparison, the macronutrient composition of human breast milk is 7 percent protein, 49 percent fat, and 44 percent carbohydrate[3]—much lower in protein and higher in carbohydrate. While human and cow breast milk have similar percentages of fat, human milk is lower in saturated fat.[4] It must be stated that people do not consume human breast milk throughout life, nor is human breast milk considered to be a sports nutrition beverage.

Many people do, however, consume cow's milk throughout their lifespan. Specifically, a number of athletes and active people use dairy foods in an effort to support an exercise regime. Built With Chocolate Milk is an athlete-targeted campaign initiated and run by MilkPEP to encourage athletes to fuel with chocolate milk and other dairy foods. MilkPEP is a dairy promotion organization funded by the government-run dairy checkoff program. According to Built With Chocolate Milk, low-fat chocolate milk is a great post-workout snack which helps athletes facilitate recovery, gain muscle, lose body fat, and return stronger the next day.[5]

Many people have listened to this message and are quick to reach for that chocolate milk after a training session. It is convenient, and if it is as nourishing as Built With Chocolate Milk makes it out to be, it would appear to be quite a valuable tool for athletes.

## *The exercising body*

To accurately assess chocolate milk's ability to enhance recovery and training adaptations, we must first look into what occurs within the body when we exercise and the factors that support efficient recovery.

Several changes occur within our bodies when we engage in physical activity. Our skeletal muscles are damaged, free radicals are formed (which induce oxidative stress), and in the case of exhaustive exercise, our glycogen stores (the body's storage of carbohydrates) are depleted. These natural physiologic responses to exercise are associated with fatigue, soreness, swelling, and temporarily reduced performance.[6,7] As a byproduct of the stress the body is experiencing during exercise, an inflammatory response is initiated to help repair the damage.

Despite these seemingly detrimental short-term side effects, exercise is a healthy practice and such consequences are not inherently bad. Regular physical activity helps prevents disease and improves quality of life.[8] Other benefits of exercise include better sleep, improved cognitive function, greater mobility, and a reduced risk of anxiety and depression.[8] Exercise training improves strength and endurance, and the temporary damage induced by training sessions allows the body to adapt and grow stronger. While excessive levels of oxidative stress have been implicated in various diseases,[9] lower levels provide a benefit[10] and are necessary for basic muscular force production.[7] Free radicals play an important role in signaling pathways involved with muscular adaptation to training.[7,11] Additionally, exercise-induced oxidative stress increases our bodies' own antioxidant production[11] as well as boosts immune function.[12] The origin and nature of these free radicals determines whether their effect on the body is beneficial or detrimental, partially explaining this paradox.[10]

However, in order to effectively recover from training, this oxidative stress must subside. Additionally, muscle glycogen must be replenished, damaged muscles repaired, and inflammation alleviated. While the human body has an exceptional ability to heal itself, optimal recovery and performance adaptations may only be realized through proper nutrition. According to the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine, the foods athletes choose to eat post-workout and throughout their daily lives play a critical role in their ability to properly recover and perform.[13]

Optimal nutrition strategies for exercise recovery are an obvious subject of scientific inquiry. It is understood that both protein and carbohydrates play major roles in an athlete's recovery, performance, and ability to adapt to increased training loads.[13] After a workout, dietary protein stimulates muscle protein synthesis and provides the body with essential amino acids to rebuild damaged tissue.[13] Carbohydrates replenish lost glycogen and help regulate training adaptations[13] while contributing heavily to daily energy needs.

Complementing exercise with meals rich in protein and carbohydrate also leads to superior performance over time. Research supports intentional post-exercise fueling as a valuable component of training,[14-18] but it is important to understand post-exercise fueling within the context of daily calorie and macronutrient requirements. To reflect the higher protein needs of athletes, the current recommendations for protein intake for athletes range from 1.2 to 2.0 g/kg/day,[13,14,19] which is higher than the Recommended Daily Allowance (RDA) of 0.8 g/kg/day.

To sustain athletes engaging in moderate to very high-intensity exercises, it is recommended to consume 5-12 g/kg/day of carbohydrates.[13,14,19] For those seeking to maximize glycogen stores or engage in ultra-endurance training, 8-12 grams of carbohydrate is recommended.[20]

While carbohydrate and protein intake is the most important considerations for recovery from exercise, this is not the only factor. A variety of micronutrients have been shown to improve recovery time and enhance exercise performance. Specifically, dietary antioxidants have been demonstrated as an ergogenic aid.[21,22] Antioxidants can inhibit exercise-induced oxidative stress, defend against muscle damage, combat delayed-onset muscle soreness, and may even increase performance.[21] Dietary antioxidants may also enhance recovery by reducing inflammation caused by training.[22] Therefore, in addition to carbohydrate- and protein-containing foods, an athlete should also consider antioxidant-rich options when selecting their post-workout snack or meal.

Another consideration for proper recovery from exercise is fluid and electrolyte balance. During exercise, water and electrolytes, namely sodium, are lost in sweat, and additional fluid will be lost in urine.[23] To adequately rehydrate from exercise and reestablish balance in the body, sodium and possibly potassium levels must be restored and fluid should be consumed in a volume greater than that which was lost during training.[23]

A diet containing adequate carbohydrates and protein, ample fluids and electrolytes, and plenty of antioxidants seems to best support recovery from exercise.

## *To what extent does chocolate milk meet these requirements?*

Chocolate milk is commonly recommended as an appropriate post-exercise recovery beverage due to the 3:1 carbohydrate-to-protein ratio and electrolyte content.[5] However, the Built With Chocolate Milk campaign neglects to mention that this ratio is not a natural quality of bovine lactation, but a result of manipulation through food processing. The natural macronutrient makeup of milk is roughly 22 percent protein, 48 percent fat, and 30 percent carbohydrate,[2] which is closer to a 3:2 carbohydrate-to-protein ratio. This balance is changed by simply adding sugar to shift the macronutrient ratio to 3:1.

Additionally, much of the chocolate milk found on the shelves is not of the low-fat variety praised by Built With Chocolate Milk. Milk is naturally high in saturated fat, which could blunt performance. Eating a single meal high in saturated fat can substantially reduce blood flow for hours after consumption.[24] Saturated fat also increases a person's risk of heart disease and type 2 diabetes—among other chronic conditions.[22] Even low-fat chocolate milk retains saturated fat. According to the *2015-2020 Dietary Guidelines for Americans*, most people consume too much saturated fat and are advised to limit intake due to its deleterious effects on various areas of health.[25]

It must also be stated that, on food labels, the butterfat content in milk products is indicated as a percentage of weight rather than a percentage of total calories. Dairy products are therefore labeled to appear low in fat when, in reality, they are not. For example, 1 percent (or low-fat milk) is only 1 percent fat by weight of the product, but this equates to 2.5 grams per eight-ounce serving, 22.5 percent fat by calories, of which 60 percent is saturated.[26]

Regarding chocolate milk's protein content, while there is a fair amount of it[2], the specific proteins and the ratio of those proteins is not ideal for accruing muscle mass. Cow's milk protein is made up of roughly 80 percent casein and 20 percent whey.[27] Casein protein is inferior to whey in stimulating muscle protein synthesis (MPS).[17] A study comparing the extent of MPS after ingestion of different protein sources found MPS to be 93 percent greater at rest after whey ingestion when compared to casein ingestion and 122 percent greater after resistance exercise than at rest.[17] Soy protein isolate also outperformed casein both at rest and after resistance exercise, by 64 and 69 percent, respectively.[17] A soy protein source would therefore be superior to a casein-dominant cow's milk protein source.

As for chocolate milk's role in rehydration, consuming a combination of fluid and electrolytes is an important component of post-workout recovery and hydration,[23] and beverages containing carbohydrates and electrolytes may assist rehydration to a greater extent than water alone.[28] Since sodium is the primary mineral lost in sweat, sodium—and potassium to a smaller extent—should be emphasized as the most important electrolyte to replenish after exercise.[29] Calcium, magnesium, iron, and other minerals are also lost through perspiration and should be replenished.[29] Chocolate milk is rich in fluids and contains these important electrolytes and minerals,[5] but it is not the only post-workout snack that can assist with rehydration. As stated by the American College of Sports Medicine, "Drinks containing sodium such as sports beverages may be helpful, but many foods can supply the needed electrolytes."[28] Additionally, while milk does contain fluid and electrolytes, alongside those come harmful compounds such as saturated fat[2,26] and estrogens,[30] which increase one's risk of developing breast cancer[31,32] and infertility.[33,34] Choosing beverages or foods that do not contain these deleterious compounds may be a more beneficial rehydration strategy.

Lastly, according to the Antioxidant Food Database, dairy products offer little in the way of antioxidants.[35] Chocolate milk does have more antioxidants than unflavored milk due to the presence of cocoa derivatives, with 2 percent chocolate milk at an antioxidant content of 0.14 to 0.17 mmol/100g.[35] Soy chocolate milk in comparison contains 0.25 to 0.30 mmol/100g, around double that of the dairy-based variety.[35] All dairy products—even chocolate milk—contain negligible levels of dietary antioxidants, a significant gap in the nutrient package that Built With Chocolate Milk fails to recognize.

Dairy foods do not attenuate oxidative stress. On the contrary—milk has been linked to oxidative effect in animal models.[36] Highlighting this distinction between the acute oxidative stress caused by exercise and a chronic oxidative state, while some level of oxidative stress is beneficial to health and performance, chronic and excessive free radical levels are implicated in disease.[9] These include cardiovascular disease, diabetes, various cancers, rheumatoid arthritis, asthma, Parkinson's, Alzheimer's, and multiple sclerosis.[9] The association between chronic oxidative stress and various illnesses poses an increased risk of all-cause mortality.[37]

Indeed, in a 2017 study of more than 98,000 women and over 45,000 men, milk consumption was found to increase mortality risk.[37] The association was stronger in women than men. These results confirmed those of a previous study that indicated a positive association between milk consumption and mortality risk.[36] In the more recent study, increased rates of death were seen in men and women who drank more milk. Higher death rates were found in men drinking three or more glasses of milk per day and in women drinking only one to two glasses per day.[37]

For athletes, considering the free radical formation caused by exercise itself, consuming dairy foods post-workout could further exacerbate oxidative stress. Conversely, a substitution of plant protein for animal protein has been linked to more favorable markers of oxidative stress and inflammation.[38] In order to facilitate recovery, more appropriate post-workout foods include beans, green leafy vegetables, seeds, nuts, whole grains, and other colorful plant foods.[39] Additionally, beverages that resemble dairy milk and protein supplements derived from soy, pea, rice, and other plants are available in most supermarkets. Longer-term, vegans and vegetarians have a higher antioxidant status compared to omnivores,[40] and eating more fruits and vegetables increases a person's own antioxidant enzyme production,[41] bolstering their defense against free radicals.

## *The ultimate recovery beverage?*

While chocolate milk certainly contains carbohydrates, protein, and electrolytes, it is not the only source of these nutrients. The detrimental side effects one endures for the sake of these common nutrients is not worth it. Athlete or not, studies have shown that in contrast to the effects of milk, which may be neutral at best, higher intakes of fruits and vegetables protect against cardiovascular disease[42-44] and some cancers,[45] while improving longevity.[42,43]

## Built With Chocolate Milk and Industry-Funded Studies

Most of us are familiar with advertisements from the dairy industry suggesting that cow's milk provides some benefit to athletes. MilkPEP's Built With Chocolate Milk campaign is an industry-funded initiative focused on educating athletes and active people about the recovery benefits provided by low-fat chocolate milk. The website features articles and other materials asserting the scientific basis for the claims behind low-fat chocolate milk as an optimal recovery beverage for athletes. As of April 2020, the website cites 22 total sources to back the campaign's nutritional claims,[1] of which 18 focus on the effect of milk consumption on markers of athletic performance and recovery. Investigation into the studies behind MilkPEP's assertions reveals conflicts of interest. One hundred percent of the cited studies that investigated milk consumption received funding or study materials directly from a company that sells or lobbies for dairy products,[2–14] or that were written by authors who have received funding from the dairy industry.[15–19] These authors were given an opportunity to report any conflicts of interest within their publication; however, most of these studies lack any such statement. Therefore, when reviewing these studies—even at the abstract level—one cannot ignore the inherent bias.

The work of Marion Nestle, Ph.D., M.P.H. and senior nutrition policy advisor in the Department of Health and Human Services (HHS) has exposed the prevalence of industry-funded studies in nutrition science— documenting how such research is often exaggerated, misleading, and even intentionally skewed in some cases.[20] Nestle's 2002 book, *Food Politics: How the Food Industry Influences Nutrition and Health,* brought to light the ways the food industry influences how consumers think about food and what they choose to eat. Nestle's book reveals the disproportionately high levels of positive results in studies that received funding from the interested party.[20] "Food companies don't want to fund studies that won't help them sell products. So I consider this kind of research marketing, not science," said Nestle in a 2018 interview.[21] It must be noted that industry funding is common across all nutrition science and should not in itself discredit the legitimacy of a study's results. We must remain skeptical, however, when assessing studies that have been industry-funded through profits and government subsidies, many of which are cited in claims made by Built With Chocolate Milk.[22] Credibility would be greater had the results of these studies been supported in research devoid of dairy industry funding, however that is not the case.

Assertions made throughout the Built With Chocolate Milk website reference a number of studies that investigated chocolate milk, plain milk or dairy-based protein supplements for their effect on performance and recovery. Muscle protein synthesis, glycogen replenishment, hydration status, $VO_2$max, perceived exertion, and endurance were some of the most common outcomes that were investigated. Each of these studies concluded favorable results of dairy consumption. While the claims the authors of these studies made were not necessarily untrue, this research was often constructed in a manner in which the desired result would be virtually guaranteed though narrowing of context within the study's design.

For example, one study cited on the Built With Chocolate Milk website,[22] *Body Composition and Strength Changes in Women with Milk and Resistance Exercise*, conducted by Josse et al. found the consumption of milk in the early post-exercise period to facilitate greater muscle mass accretion, strength gains, and fat mass loss in women.[7] This result, however, is far less meaningful than it may sound. The conclusion was based on a comparison between chocolate milk and a carbohydrate drink devoid of protein. There is substantial science in the area of strength training which points to the importance of consuming not only carbohydrates, but also protein in order to accrue maximal gains in muscle mass and strength.[23,24] The consumption of carbohydrates alone has little effect on muscle protein synthesis,[25] which is the primary mechanism through which these metrics are improved.[24] Chocolate milk contains both carbohydrates and protein.[26] Through design, these researchers were able to distort the advantages of chocolate milk by comparing milk to a control which lacked the necessary protein to facilitate muscle protein synthesis. In essence, the study tested the question of whether combining protein with carbohydrates would positively influence physiological adaptations to resistance exercise—specifically strength and body composition. But the answer to this question is already known in the sports nutrition community. The results of this study do not in any way assert that chocolate milk is superior to any post-workout snack that contains the protein and carbohydrates necessary for muscle mass accretion. To the average reader, this detail may not be obvious, making the context of the study's results easily misconstrued. Built With Chocolate Milk distracts the consumer from the facts, exploits consumers' misunderstanding of scientific literature, and encourages them to take their claims at face value.

Of note, Josse et al. received funding from Dairy Farmers of Canada and The Dairy Research Institute to conduct this study. As the report reads: the authors compared fat-free milk to simple carbohydrate "with the general goal of promoting the consumption of healthy, low-fat dairy foods that are recommended for this population."[7] Their intention was clear. The goal of the study was to create a scenario that would frame milk positively and improve public perception. The authors expressed that they held the bias that low-fat dairy foods were "healthy" prior to their actual investigation.[7] The mention of this unsubstantiated assumption is disingenuous at best, deliberately misleading at worst.

In another study, Potter et al. compared chocolate milk to water for endurance among climbers who had undergone exhaustive exercise.[14] Participants were able to climb for longer and further the day after exhaustive exercise when recovering with chocolate milk. When evaluating the results of the study, we must keep in mind that chocolate milk contains calories while water does not. *Any calories* will aid recovery and performance to a greater extent than no calories, so it would only make sense that chocolate milk or any other calorie-containing beverage or food would facilitate a similar improvement in climbing performance. Here again, researchers narrowed context and made use of inappropriate comparison to overplay the usefulness of chocolate milk for athletes.

## *What can we take away from these studies?*

Although it would appear that chocolate milk is a better post-workout recovery snack than a sports drink or water, there is no indication that milk is the best choice among other post-workout foods. In fact, a 2018 systematic review and meta-analysis of 12 peer-reviewed controlled clinical trials looked into chocolate milk consumption, exercise performance, and recovery markers. The authors found chocolate milk to have no significant effect on time to exhaustion, rate of perceived exertion, heart rate, markers of soreness and fatigue, or markers of muscle damage when compared to sports drinks or the placebo.[27] Chocolate milk did outperform other test beverages on two metrics—milk performed better than the placebo (flavored or sweetened water) in decreasing post-exercise fatigue and soreness as well as increasing the amount of time a person was able to sustain exercise when compared specifically to the placebo or to beverages containing carbohydrates, protein, and fat—but overall, no statistically significant benefit derived from chocolate milk consumption was found in the study.

Studies do show that the carbohydrates, protein, and electrolytes contained in chocolate milk may facilitate greater training adaptations and better recovery than water or drinks devoid of protein. However, as we have examined, chocolate milk also contains a host of deleterious components—undermining the benefits of the nutrients milk does contain. There are a number of post-workout alternatives that also contain carbohydrates, protein, and electrolytes but do not come with the baggage of impaired artery function, inflammation, and intestinal discomfort associated with dairy products.

# Clinical Perspectives on Athletes and Cow's Milk Consumption

## Exercise, Hormones and Women's Health

Our hormones are intimately involved in physiological processes such as energy metabolism, body composition, mood, and multiple other domains. It follows that our hormones play a large role in exercise and our response to training. The widespread use of hormone therapy among athletes confirms this notion. For decades, competitive athletes have been illegally dosing themselves with hormones—testosterone, human growth hormone (HGH), erythropoietin (EPO)—all to give themselves a competitive edge.

Most people are not elite or professional athletes and taking supplemental hormones for exercise performance is not the experience of the average human. But hormones influence our capacity to exercise, and their physiological response to training stimuli and the foods we eat have a large effect on our hormonal system. In turn, hormones may influence performance.

Menstruation is the result of natural hormonal fluctuations in premenopausal women. These shifts have the potential to impair exercise performance, specifically endurance exercise,[1] and for some women, may leave them feeling debilitated. Many women experience menstrual-related pain (premenstrual syndrome—PMS) that is so severe they are unable to function for a day or two at a time, let alone exercise. This is a legitimate issue for competitive athletes who must maintain a consistently high level of training, leaving no room for unplanned days off. Cramping alone can render a woman unable to follow through on a training session—an issue for recreational and competitive athletes alike. Additionally, changes in mood around the time of menstruation can increase vulnerability to depression,[2] which presents another barrier between a woman and her workout. Feeling depressed before and during PMS is common and can affect not just performance, but general productivity and quality of life as well.

Dr. Neal Barnard and his team conducted a study looking at the role of diet in the severity of menstrual symptoms including cramping and depression. They found that women who switched to a plant-based diet devoid of animal products saw a significant reduction in the duration and intensity of menstrual cramping.[3] Premenstrual symptoms also decreased in duration. The intervention was so effective that many women refused to follow through with the crossover arm of the study in which they transitioned back to their typical diet.

A number of premenstrual and menstrual symptoms are related to an excess of estrogens in the body.[4] Eating a plant-centered diet that is rich in fiber may be a valuable tool for women in reducing these symptoms since dietary fiber increases excess estrogen elimination from the body.[5] Dairy products are particularly problematic in this regard for two reasons: they contain bovine estrogens—the ingestion of which significantly increases estrogen levels in the body[6]—and they contain no fiber. Accordingly, they provide no opportunity for estrogen elimination by way of fiber in the gastrointestinal tract, leading to additional estrogen absorption. Dairy products account for 60-80 percent of the female sex steroids that people consume through food sources.[7] High-fat dairy products like cheese and butter may be of particular concern. Estrogens dissolve in fat cells—therefore the higher a milk product's fat content is, the more estrogens it retains. Additionally, consuming high-fat foods, such as dairy, can increase the level of estrogens in the body.[8]

There is some evidence that animal protein may be a driver of PMS-related performance impairment in athletes. Researchers surveyed female athletes at a Japanese university and found that women who experienced PMS-related impairment in athletic performance ate more protein from animal sources like milk, cheese, and yogurt, and less from plant sources. Dairy and other animal-based protein had negative effects on both physical and emotional symptoms related to PMS in these women. The researchers concluded that a low proportion of plant protein in the diet may be a factor in PMS symptoms impede the progress of training and performance.[9] Based on their results, substituting protein from plant sources for animal sources like milk and dairy products could be a potential performance booster.

People who exercise frequently may find difficulty consuming enough calories to replenish what they burn from training. Clinically referred to as Relative Energy Deficiency in Sport (RED-S), eating too little is common among athletes and puts them at a heightened risk for hormonal imbalances. We know that disruption of the endocrine system can impair sports performance and yield adverse health effects.[10] Considering the presence of bovine sex hormones in cow's milk and milk's ability to significantly influence human estrogen levels, abstaining from dairy foods may be a wise strategy for athletes.

Presented here is just a portion of the interactions between hormones, athletic performance, and health. All dairy products contain hormones, and their consumption could result in deleterious health consequences related to cancer[11,12] and fertility.[3,13,14] In healthy women, the body is generally able to regulate its own hormone levels through a variety of feedback loops, but the addition of exogenous hormones through dietary sources can overwhelm these mechanisms, causing issues around the time of menstruation that may be difficult to bear.[15]

## The Addictive Nature of Dairy Products

While many adults lightheartedly joke that they may be "addicted to cheese," there is biochemical evidence to support dependency to this commercially produced dairy product.[1,2] Though some people simply enjoy dairy products, many claim to crave it and sincerely believe they could never go without this food. This could be due to the nutritional makeup of cheese, not just lack of willpower.

Milk products contain casomorphins—morphine-like casein fragments.[3] When a person consumes dairy foods, these casomorphins bind to their opioid receptors[3–5] in the same way that heroin does.[6] While these are mild opiates compared to prescription painkillers, they nonetheless elicit a reward response.[3,5]

Casomorphins are naturally found in all mammals' milk, including human breast milk.[7,8] These compounds play an important role in the mother-infant bond—ensuring the baby's interest in nursing and supporting adequate nutrition.[7] However, humans are biologically designed to cease milk intake within the first few years of life as they transition to solid foods. While we are born with the ability to digest the milk sugar lactose, most lose this ability with age—our bodies stop producing the lactase enzyme required to do this work. While milk is important for early infant development, there is no biological justification for its consumption throughout life. Similarly, casomorphins provide an essential biological service to infants, but their usefulness comes to an end after nursing. The continued ingestion of dietary casomorphins into childhood, adolescence, and adulthood exploits their natural function and encourages compulsive, habitual behavior.

In addition to casomorphins, two other habit-forming compounds found in cheese are salt[9] and fat.[2] Cheese is the number one source of saturated fat in the American diet, according to the National Cancer Institute.[10] Pizza (with cheese) is number two. The fat content in cheese is high because it is a concentrated form of fermented cow's milk, which is already high in fat (one pound of cheese requires roughly 10 pounds of milk to produce).[11] Most cheeses are made from whole milk, of which 10 pounds would contain roughly 1,131 calories of dietary fat.[12] During the cheesemaking process, most of the milk's water is lost, leaving a high concentration of fat. Cheddar cheese, for example, is 73 percent fat by total calories.[13] Coupled with its high-fat content, cheese also contains a great deal of sodium. On average, one one-ounce serving of cheddar cheese contains 8 percent of the daily recommendation for sodium, while a serving of processed cheese like Kraft Singles contains 18 percent.[14]

The dairy industry has capitalized on the habit-forming potential of cheese and other dairy products to increase sales. Using the Freedom of Information Act, attorneys at the Physicians Committee for Responsible Medicine (PCRM) gained access to internal documents of Dairy Management Inc. (DMI)—the organization at the heart of the dairy checkoff. Among the resources obtained by PCRM was a slideshow from the 2000 Cheese Forum in which DMI's vice president of cheese marketing, Dick Cooper, outlined a plan to "trigger the cheese craving."[1] DMI created an intensive strategy which partnered the industry with some of the nation's largest fast-food chains. Together, they worked to increase consumer cheese consumption and encouraged mass cheese cravings. These partnerships—which continue to be forged—include Wendy's, McDonald's, Domino's, Papa John's, Taco Bell, Subway, Starbucks, and Pizza Hut.[1]

## Milk and Issues of Respiration

James Loomis Jr., MD

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If there is one thing an athlete needs most, it's the ability to take a good, deep breath. However, many of the athletes I cared for as the team doctor for the St. Louis Rams and St. Louis Cardinals suffered from asthma. Asthma is also the most common chronic medical condition found in Olympic athletes.[1] At the Atlanta Games in 1996, 20 percent of the US team had asthma, and in 2004 in Athens, nearly 21 percent of the British team were diagnosed with asthma.[2] Asthma is, to put it lightly, a nuisance to performance and is experienced by athletes of all levels. Many of these athletes have experienced improvement or remission in their asthma symptoms after giving up dairy and moving toward a plant-strong diet.

Why does avoiding dairy help athletes with asthma? There are several reasons—all related to inflammation. Cow's milk allergy (CMA) is one of the most common food allergies found in children.[3] The allergy is typically to one of the proteins found in milk: casein—which makes up about 80 percent of milk protein—or whey, which makes up the remainder.[4] CMA can cause respiratory symptoms such as wheezing, coughing, shortness of breath, runny nose, and gastrointestinal (GI) symptoms such as stomach cramps and diarrhea.[5] In fact, 45 percent of children with asthma also have dairy and other food allergies.[6] Further, children with food allergies—such as CMA—are up to four times more likely to have asthma or other allergic conditions than children without food allergies.[7] CMA often persists into adulthood and there is some evidence that the prevalence may even be higher in adults.[3]

Even in children without CMA, a Western diet high in saturated fat and processed foods is a significant risk factor for developing asthma.[8] This makes sense, because asthma is a disease of chronic inflammation and we know that saturated fat has a pro-inflammatory effect in the body. High-fat diets have been shown to stimulate inflammatory cell activity in asthmatics.[9] Furthermore, a reduction of dietary saturated fat intake has the ability to reduce the presence of these inflammatory cells.[10] Dairy products happen to be the greatest contributor of saturated fat to the American diet.[11] Conversely, an anti-inflammatory diet high in fruits and vegetables has been shown to improve lung function in asthmatic adults[12] and appears to be protective against asthma in adolescence and children.[13]

We know that asthma is prevalent in the adult population and among athletes.[1,2] Consuming cow's milk can cause inflammation of the airway regardless of whether or not a person suffers from asthma or CMA. Because of their inflammatory nature, dairy products are not appropriate as a performance fuel nor a recovery aid. There are any number of alternative post-workout snacks that support recovery without detracting from health. See *Resources* (page 44) for examples.

## Health Concerns and Performance Implications

Susan Levin, MS, RD, CSSD

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### *Bone health*

While it is essential to have enough calcium in the diet to support bone remodeling, research suggests that getting more than about 600 milligrams per day—easily achieved without dairy products or calcium supplements—does not protect us from a hip fracture.[1] And plant foods are the most healthful source of calcium, as well as other nutrients commonly considered exclusive to dairy products.[2]

In fact, research shows that dairy products have little or no benefit for bones.[3,4] A 2005 review published in the journal Pediatrics showed that drinking milk does not improve bone strength in children.[3] In another study, researchers tracked the diets, exercise, and stress fracture rates of young girls for seven years and concluded that dairy products and calcium do not prevent stress fractures in adolescent girls.[4]

Healthy bones need more than just calcium. Vitamins D and K are important[5] as is consuming less salt[6] and more fruits and vegetables.[6,7] Milk does not naturally contain vitamin D. Rather, it's added to milk in a process called fortification. Lastly, weight-bearing exercise is one the most effective ways to increase bone density and decrease the risk of osteoporosis.[8,9] Simply ingesting dietary calcium alone will not guarantee strong bones and consuming it by way of dairy products is not a well-supported strategy for the prevention of osteoporosis. The nutrients found in cow's milk are readily available in more healthful plant sources or, as is the case with vitamin D, in fortified plant products and from the sun.

### *Blood flow and tissue oxygenation*

Dairy products contribute significant amounts of cholesterol and saturated fat to the diet. In fact, dairy is the number one source of saturated fat in the American diet.[10] Animal fats impair arterial health and increase blood viscosity,[11] which impedes oxygen delivery to muscles and other tissues, thus retarding athletic performance.[12] The higher the saturated fat in the diet, the worse blood flow is.[13] Diets high in fat, and especially in saturated fat, can increase the risk of heart disease and stroke and can cause other serious health problems.[14,15] Conversely, a plant-based diet that eliminates dairy products reduces blood viscosity.[16] Blood flow depends not only on the health of the blood, but also on the ability of the arteries to push blood throughout the body efficiently. Clinical trials repeatedly show that the more saturated fat in the diet, the greater the impairment of vasodilation, or the stiffer the arteries.[11,17,18]

On the other hand, a low-fat, plant-based diet, in combination with exercise, smoking cessation, and stress management, can not only lower heart disease risk,[19] evidence proves it can even reverse it.[20–23]

## *Lactose intolerance*

The loss of lactase enzymes after early childhood is a natural part of human development. Only among Caucasians is lactase persistence common.[24,25] The National Institutes of Health estimates 95 percent of Asians Americans, 60-80 percent of African Americans and Ashkenazi Jews, 80-100 percent of Native Americans, and 50-80 percent of Hispanics are lactose intolerant.[24] For affected individuals, milk ingestion can cause bloating, diarrhea, and gas.

If cow's milk provides no protection for bones, impedes blood flow, and causes gastrointestinal distress, perhaps an athlete should think twice before reaching for that jar of whey protein or the bottle of chocolate milk.

## Athletes Seeking a Healthy Gut for Optimal Performance

Angie Sadeghi, MD

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The gastrointestinal tract harbors 100 trillion organisms from mouth to anus. Combined, these organisms are commonly referred to as the microbiome and make up the largest organ in the body—containing 100 times more genetics than our own eukaryotic cells. The majority of these organisms reside in the colon where they are involved with innumerable biochemical reactions. Based on the food one consumes, these reactions can promote health or disease. That being said, nutrition plays an essential role in athletic performance. Generally, in sports performance, we want to maintain adequate nutrition, a healthy weight, optimal protein (including branched-chain amino acids), control of markers of disease, proper levels of carbohydrates to fuel high-performance exercise, and sufficient energy intake. We want to do this, all while not impairing exercise by feeling too bloated.

Unfortunately, dietary recommendations for elite athletes are primarily based on a high protein, low fiber diet, which is associated with reduced microbiota diversity and functionality[1] (e.g. less synthesis of by-products such as short-chain fatty acids which play a pivotal role in skeletal muscle function). Since many elite athletes suffer from gastrointestinal conditions,[2] coaches should focus on making recommendations that meet the criteria at the macronutrient level, but also contribute to a healthy digestion and microbiome diversity. As a gastroenterologist who specializes in gut health and fitness, I'm always surprised to see athletes who consume foods that may diminish their performance. The dairy industry heavily advertises cow's milk as the beverage of choice for athletes, but many coaches who promote chocolate milk and whey protein never look into the actual science. Here is what the science has taught us.

### *Lactose causes GI upset and fatigue*

Lactose (milk sugar) is the main source of carbohydrate in breast milk (of any species) and is suited for infants who are uniquely adapted to lactose-based nutrition. Cow's milk contains approximately 12.5g lactose in a typical serving size of 250mL (or one cup).[3] Digestion and absorption of lactose takes place in the small intestine by an enzyme along the brush border of villi in the small bowel, called lactase.[4] Diminished expression of this enzyme is common and known as lactase deficiency.[5] When a person who is lactase deficient consumes lactose, it will lead to lactose malabsorption which manifests as abdominal pain, bloating, constipation, or diarrhea.[4,5] The activity of lactase in the small intestine reaches a peak at the time of birth but is reduced in most populations during early childhood. The undigested lactose in the small intestine leads to trapping of water in the colon, causing significant diarrhea.[6]

Worldwide, most individuals have lactose intolerance.[4] A recent meta-analysis estimated the prevalence of lactose malabsorption worldwide at 68 percent.[7] Therefore, statistically speaking, out of the 13,000 athletes who compete at the Summer and Winter Olympic Games, about 8,840 of them would have varying degrees of gastrointestinal problems during their training and even while competing for a medal if they consume dairy.

Many individuals develop symptoms of intolerance rather than malabsorption. These symptoms may include abdominal pain, borborygmi (rumbling tummy), and significant gas and bloating after lactose intake. The onset of these symptoms is strongly correlated to the appearance of hydrogen gas during breath tests which is seen in a condition called small intestinal bacteria overgrowth (SIBO) and IBS. So perhaps drinking cow's milk could be involved in the overgrowth of small intestinal bacteria seen in SIBO. Products of lactose fermentation by the colonic organisms may also trigger fatigue and neurological symptoms. A recent review of results from over 2,000 patients reported a high frequency of neurological symptoms such as tiredness and headache after lactose ingestion,[8] posing a significant problem for athletes in the face of completing or winning a competition.

## *Lactose intolerance may lead to microbiome dysbiosis and irritable bowel syndrome*

Undigested lactose travels through the gastrointestinal tract and is fermented in the colon, producing carbon dioxide, hydrogen gas, and methane by gas-producing microbes. However, does it lead to dysbiosis (a microbial imbalance) and/or irritable bowel syndrome?

The relationship of lactose intolerance and irritable bowel syndrome has been extensively studied in a South Chinese population with near 100 percent lactose intolerance on genetic testing. A double-blinded, randomized, cross-over comparison of lactose tolerance at 10, 20, and 40g lactose was performed in IBS patients with diarrhea (IBS-D) and healthy controls. This study demonstrated a very strong correlation between the appearance of hydrogen gas in the breath and reports of bloating, pain, and other symptoms in patients with lactose intolerance. Symptoms of intestinal gas production were increased in patients with IBS-D.[9] Further research has demonstrated that pain of the inner organs and high levels of gas production on breath tests all increased the severity of abdominal symptoms after ingestion of 20g lactose,[10] an amount that may be found in about one and a half servings of milk.

Moreover, biopsies from the small intestine and colon have shown increased numbers of inflammatory cells in lactose-sensitive patients. The type of inflammatory cells shown to increase include mast cells (increase in response to allergies) and lymphocytes (white cells in response to infection and inflammation) in lactose-sensitive patients. Furthermore, studies have shown that lactose ingestion spurs the release of substances known as inflammatory cytokines, which are triggered by inflammation and used to recruit other inflammatory white cells.[11] The cause of irritable bowel syndrome remains elusive, but dairy products should be considered as a potential underlying promoter of IBS.

## *Implications for athletes*

As far as athletes are concerned, drinking cow's milk may create several problems:

1) Cow's milk consumption could cause a vicious cycle of inflammation which could interfere with athletic performance.
2) Athletes who use cow's milk as a sports nutrition beverage risk abdominal discomfort, bloating/distension, gas, diarrhea, and/or constipation.
3) Athletes commonly report symptoms consistent with IBS[12] and dairy consumption can worsen such symptoms.[9,10]

## *Excessive intake of sulfate-producing foods can potentially damage the gut*

Significant amounts of sulfur-containing amino acids are found in cow's milk and cheese.[13] Consumption of large amounts of these foods may significantly increase sulfide production in the colon by the colonic bacteria.[14] Most of the bacteria live inside the colon in a symbiotic relationship with us humans as the host. Sulfate-producing bacteria are members of the normal colonic flora and they ferment the amino acids from dairy to produce hydrogen sulfide, which is toxic to human cells.[15]

Research found the elimination of milk and cheese from the diet of ulcerative colitis (an inflammatory bowel disease which manifests as ulcers in the colon) sufferers results in substantial therapeutic benefit, suggesting that reducing the intake of sulfur-containing amino acids decreases colonic production of sulfide.[16] Indeed, sulfur-containing foods were positively associated with ulcerative colitis relapse in a 2015 review.[17]

## *A high protein beverage is not necessarily healthy*

Drinking milk for protein (or calcium) is like drinking soda for potassium. The studies show that athletes need to consume about 1.2 to 2.0 grams of protein per kilogram of lean body weight per day.[18-20] This is important regarding muscle regeneration and recovery. However, in excess, protein may cause harm. When a person eats more dietary protein than they are able to digest, some of it may escape digestion in the small bowel and enter the colon largely intact, where it is fermented by the colonic microflora. The resulting end products include branched-chain fatty acids (e.g., isovalerate, isobutyrate, and 2-methylbutyrate) and potentially harmful metabolites (ammonia, amines, phenols, sulfide, and indoles).[21-23] Ammonia reduces the lifespan of intestinal cells and is considered to be toxic to healthy cells—potentially promoting cancer growth.[24] The production of these toxic compounds is directly related to dietary protein intake,[24] a reduction of which can decrease the production of harmful by-products.

In comparison to diets high in overall protein, diets high in animal protein have specific effects on intestinal microflora.[25-27] Ingestion of large amounts of animal protein does increase the activity of certain bacterial enzymes, which may result in increased release of potentially toxic metabolites in the bowel.[28]

## *The fatigued athlete*

Fatigue management in an athlete's training is important for performance because adequate recovery allows athletes to train harder and more vigorously while avoiding injuries, and it all starts in the gut. Most coaches design their athletes' nutrition around how quickly they can recover, because effective nutrition and hydration are key strategies for optimizing recovery. The gastrointestinal tract plays an important role in the absorption of nutrients, but the normal absorptive capacity of healthy nutrients could be interrupted which negates their health benefits.

Research has shown that drinks such as beetroot juice—which is a rich source of antioxidants and high in nitrates—can improve athletic performance.[29] Nitrate is a chemical naturally occurring in certain foods, which our bodies convert to nitric oxide. Nitric oxide is a potent molecule that increases blood flow, improves lung function, and strengthens muscle contraction. Furthermore, beetroot juice aids in recovery by preserving muscle function and improving cardiorespiratory fitness.[29] In addition to its nitrates, beetroot contains antioxidants which may further benefit recovery by reducing oxidative stress and inflammation.[30] There are other types of antioxidants including vitamin C, vitamin E, and beta-carotene—which like polyphenols[31] help repair cellular damage.[32] Polyphenols (of which 8,000 have been identified) are a class of phytonutrients that are found only in plant-based foods. Consumption of these foods is key in improving and expediting recovery in athletes.

On the other hand, studies have shown that cow's milk reduces the health benefits of antioxidant-rich foods by reducing the absorption of polyphenols and blocking the antioxidant effects.[33-35] In a study of cocoa and milk, the addition of milk reduced the antioxidant capacity of cocoa products by 30 percent.[33]

In another study where researchers tested antioxidant activity of blueberries in association with milk, when milk and blueberries were ingested together, there was a reduction in the antioxidant properties of blueberries and reduced nutrient absorption.[34] Research finds that the alpha-casein protein in milk binds to antioxidants and prevents their absorption.[35]

In conclusion, when it comes to optimizing nutrition for athletes, a milk beverage may have to take the back seat in favor of nutritious, antioxidant-rich food and drinks which can facilitate faster recovery.

# Hazards of Long-Term Cow's Milk Consumption

## Chronic Consumption Leads to Chronic Disease

Michael Klaper, MD

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The growth of an infant calf fueled by its mother's milk borders on the miraculous. As the newly born bovine swallows the sweet white liquid from its mother's udder, a flood of complex proteins—such as casein, whey, and lactalbumin—is swallowed, digested, and absorbed. Amino acids are absorbed and travel through the liver, which responds in a manner that is powerful and appropriate for a growing infant. The liver, in turn, releases a surge of insulin-like growth factor 1 (IGF-1), a growth-promoting hormone that starts turning the gears of cellular growth and forming tissues throughout the body. As IGF-1 flows through the newly born cells, mTORC1-producing genes are activated. mTORC1 is an enzyme protein that sends the chemical message to cells throughout the body, "Grow! Proliferate! Persist!"[1]

As an infant calf suckles on its mother's teat, the tissues throughout its body respond to the increased mTORC1.[2] Protein is produced, cells divide, membranes thicken, secretions increase, and the miraculous transformation of a 100 lb calf into a 1000-pound dairy cow proceeds apace.

The foregoing is biology obeying a primal mandate of natural law—bovine milk fueling rapid but orderly growth in the young bovine body for which milk was intended. However, when this same bovine growth fluid is swallowed by a young (or old) human body, the effects are often not so benign, especially when that person is genetically prone to diseases such as asthma, acne, diabetes, or Parkinson's disease.

### *Asthma*

Infants and young children are often the first to show adverse effects of ingesting cow's milk protein as their parents hear the chronic cough and telltale wheeze that signify the swollen, reactive bronchial membranes of asthma.[3–5] Several mechanisms—from increased production of pro-inflammatory interleukin-17 in the blood[3] to higher infection-spawning mucus production[4] resulting from beta-casomorphin stimulation[5]—may be involved, suggesting that dairy products are foods to be avoided by asthmatic children. Several studies indicate that dairy-free diets produce fewer asthmatic children,[3,6] and the elimination of dairy products often results in dramatic improvement of asthma in young people.[5,7,8] Yet, most pulmonologists rarely ask about their patients' diets. In my professional opinion, that is where they should start their treatment suggestions.

## *Type 1 diabetes*

Every parent's nightmare—their young child condemned to a lifetime of injecting themselves with insulin needles after being diagnosed with Type 1 diabetes—often rears its ugly head between the ages of five and 10 years.

Type 1 diabetes is characterized by an assault on a child's pancreas wherein the insulin-producing beta cells are destroyed. Various proteins found in cow's milk have been suggested as triggers of this autoimmune-mediated beta cell apoptosis.[9–13] Antibodies created in response to the ingestion of foreign cow's milk proteins turn upon the beta cells in the child's pancreas and destroy them.[9,10] Continued consumption of milk keeps IGF-1 levels elevated[14,15] which fosters more overstimulation of beta cells, leading more of them to disappear through "beta cell exhaustion,"[15] rendering the child unable to manufacture their own insulin.

In classic type 2 diabetes, the beta cells produce ample insulin, but due to the presence of fat molecules within muscle cells, they do not respond as well to insulin's signal to take in glucose from the bloodstream.[16]

This insulin resistance can be worsened by an overlay of obesity, often driven by favorite fat-fostering culprits—chocolate milk, cheese, and ice cream. The mechanism involves a principle known as "oxidative priority" which dictates that when a combination of sugar and fat is consumed, the sugar will be metabolized immediately for energy while the fat is stored for later use in adipose tissue as an emergency fuel to be used during fasting or starvation.[17] This is a logical and potentially life-saving strategy by the body in times of food scarcity, but, in today's world of constant calorie excess, it also can result in excess stored fat in the cells of the muscles and liver, as well as under the skin, and in the abdomen.

As the fat accumulates inside these cells, it promotes insulin resistance by being oxidized, causing reactive molecules to accumulate within the cells. These molecules then stifle the enzymes that answer to insulin's signal to allow glucose from the blood to enter the cells to be burned.[18] As glucose is not as readily able to be taken in by muscle cells, it collects in the bloodstream, creating the classic high blood sugars of diabetes.

In this way, the insulin sensitivity of a type 2 diabetic is further impaired. In the case of type 1 diabetics, a new layer of insulin resistance is added to the child's burden of low insulin production. At this stage, even if her pancreas is still producing a whisper of insulin, the chocolate milk-drinking, insulin-resistant child may find she needs ever more insulin to maintain safe blood sugar levels, priming her body for fat storage. As her weight increases, so does her risk of developing further health complications, in a self-perpetuating cycle of disease.[19] This tragic diabetes picture is seldom seen in cultures that do not routinely drink cow's milk.[20] Adoption of a dairy-free, plant-based diet restores the function of the insulin receptors and usually results in dramatic improvement of insulin resistance and clearing of the glucose intolerance.[21]

Many people now choose low-fat dairy products with the belief that these products are healthy. However, reducing the butterfat in some products does not remove most of the other health hazards found in cow's milk products. There is no indication that the bovine estrogens,[22] IGF-1-stimulating proteins,[14] leukemia viruses,[23] and pus cells[24] found in cow's milk would somehow escape being present in low-fat dairy products. In fact, the concentration of these contaminants may actually increase as the fat and other diluting molecules are removed during the "skimming" process. The answer lies not in "skimming milk" but in skipping milk.

### *Acne*

The bathroom mirror is often the next place the health-disrupting effects of cow's milk in the human body are revealed. There, teenagers often gaze in dismay as they see how the IGF-1 from their liver has turned on genes which makes the oil glands in the skin produce a particularly thick and acidic secretion called sebum.[25] Acidic sebum clogs and inflames the oil glands in the skin, heralding a crop of acne comedones that can become full-blown infected pimples that can lead to disfiguring scarring that crumples confidence and distorts social interactions through the person's life. The ability of casein protein to stimulate IGF-1 production—which drives the acne-spawning sebum formation—is well documented.[26] Acne is virtually never found in cultures that do not consume cow's milk.[27] That being said, the elimination of cow's milk often results in dramatic clearing of the skin from the ravages of acne.[28]

### *Parkinson's disease*

For those who continue to ingest baby calf growth fluid throughout their adult lives, their brain may be the most important organ to pay the price. There has long been an association noticed between dairy product consumption and the development of Parkinson's disease.[29,30] Here it appears to be the galactose sugar that injures the cells of the substantia nigra in the brainstem which are responsible for initiating and controlling fine motor movement.[29] It is sadly ironic to think that a product marketed as "Nature's perfect food" may play a major role in fostering Parkinson's disease, which steals our ability to walk, talk and even think and laugh in our advanced years.

In summary, cow's milk is perfectly suited to support the rapid growth of a calf. Considering cow's milk's basic biological function, it should be of no surprise that consuming baby calf growth formula can contribute to dysfunction and disease in the human body at any age. Milk, butter, cheese, and other dairy-based foods can all too often show their damaging potential in the unlucky children predisposed to type 1 diabetes, asthma, and acne. However, their most insidious impacts may be to those who are lifelong consumers of cow's milk if it increases their risk of Parkinson's disease which removes years from ones' life and life from one's years.

## Associations Between Dairy and Breast Cancer

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Breast cancer is the most common cancer in women[1] and also affects some men.[2] Estimates are that one in eight women will develop invasive breast cancer over the course of her lifetime.[3] In the US specifically, breast cancer accounts for 30 percent of all cancers diagnosed in women.[3] In 2020 alone, researchers have predicted 276,480 new cases of invasive breast cancer in addition to the 3.5 million women who already have a history of the disease.[3] Also within this year, approximately 42,170 people are expected to die from breast cancer.[3]

Due to breast cancer's multifactorial nature, it is important to address the disease through different avenues of health. One of the most important approaches to breast cancer prevention is through nutrition. For decades, dietary choices have played a major role in the prevention of breast cancer, and research has established that plant-forward diets have significant effects on reducing the incidence of cancer.[4] Conversely, processed[5] and animal-based foods[6] have been shown to significantly increase cancer risk.

Dairy consumption, specifically, raises concerns in relation to breast cancer. On the surface, dairy is nutritive in vitamins, minerals, and protein. Unfortunately, these nutrients are wrapped in artery-crippling saturated and trans fat,[7] hormones,[8] antibiotics,[9] carcinogenic proteins,[10,11] and environmental toxins.[12,13] The main mechanisms through which dairy is thought to contribute to breast cancer growth include the effects of exogenous IGF-1 and bovine estrogens consumed in cow's milk[14] and the high concentration of harmful fats in many dairy foods.[15]

Multiple studies have shown an increased risk of breast cancer in those with elevated IGF-1 levels in their blood.[16–18] In fact, we see the upregulation of IGF-1 receptors in breast tumors as highlighted by researchers Weroha and Haluska, "The extent of IGF-1R expression in breast cancer varies by methodology but may approach 90 percent of tumors... IGF-1 contributes to breast cancer growth by promoting cell proliferation and chemotherapy resistance."[19] Dairy can add IGF-1 to the body directly through consumption but also stimulates endogenous production of the hormone as well. Those who regularly consume milk show high levels of IGF-1.[20,21] Heaney et al. conducted a randomized intervention study of 204 healthy men and women between the ages of 55 and 85. Over a 12-week period, those who consumed three or more servings of nonfat or one-percent milk per day had a statistically significant ten percent increase in serum IGF-1 levels.[21] Considering the USDA and HHS recommendation for milk consumption in adults is three cups per day, this is cause for concern, especially in people with a family history of breast cancer. IGF-1 stands as one of the most problematic constituents in milk and other dairy products.

The saturated and trans fat found in dairy provide yet another concern when it comes to breast cancer risk. One cup of whole cow's milk contains 21 percent of our recommended saturated fat daily value.[7] Multiple meta-analyses have found an increased risk of breast cancer with increased consumption of saturated fat.[22–24] Further, Kroenke et al. found that high-fat dairy was associated with a higher risk of mortality after a breast cancer diagnosis.[15] A link between trans fats and breast cancer also exists.[25]

Dairy foods have also been associated with other hormonal cancers including prostate, ovarian, testicular, and endometrial.[26-29] One theory to explain the connection between high-fat dairy and the incidence of breast cancer is the presence of steroid hormones in dairy, particularly estrogens.[15] "High-fat dairy consumption," according to Kroenke et al., "may increase levels of estrogens, which may augment the risk of breast cancer recurrence and mortality."[15] According to Kroenke, "women consuming one or more servings per day of high-fat dairy had … a 49 percent increased risk of dying from their breast cancer during the follow-up period."

Women in this group also had a 64 percent higher risk of dying from any cause.[30] This notion was echoed by Pape-Zambito et al. who found that the concentration of bovine estrogens in dairy foods markedly increased as the source became fattier, with butter having the highest concentration.[31]

Previous research has linked high estrogen exposure with an increased risk in the development of breast cancer.[32,33] Estrogens increase cellular replication and can cause DNA damage, which may contribute to carcinogenesis.[34] With 70-80 percent of breast cancers being hormone-dependent,[35] exogenous dietary hormones should be avoided to reduce one's risk. For those who consume animal products, the main source of animal-based estrogens (60-70 percent) in the diet comes from dairy foods.[36] With that in mind, the elimination of dairy from the diet may be an impactful intervention in reducing one's risk of breast cancer or improving prognosis.

With the advent, improvement, and accessibility of plant-based alternatives to dairy, it is easier than ever to choose a healthier option to the foods many of us were raised on. While some still raise questions about the direct causal effect of dairy and breast cancer, what is certain is that multiple components of dairy have been shown to promote and/or progress this deadly and far too common disease. With this knowledge, we can all make healthier choices and encourage our loved ones to do the same.

## Toxins and Environmental Impact of Dairy

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Milk is a lifeline of communication—a communication of hormonal, microbial, and environmental data from mother to child. Breast milk is the medium through which the mother transfers vital nutrients and information to the child's body. All animals are in constant communication with the environment around them and pass on what they have experienced (for better or for worse) to their offspring via their microbial and animal DNA. This means that each species' and every individual animal's milk is unique in this communication because milk is always adapting.[1]

If you are not a baby calf, it is not wise to drink the milk intended for that baby calf because there is much more being transferred than meets the eye. We know that the nutrient ratios, hormones, microbes, hydration, and other components of cow's milk are not designed for human consumption.[2] We are aware of the fact that humans (and all mammals) are naturally designed to breastfeed for a limited period of time—not consume breast milk their entire life, as humans have grown to do. Even excluding these factors, there is still much to be concerned about when it comes to consuming dairy products, and exposure to environmental pollutants is one of them.

Microplastics, polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), dioxins, and heavy metals such as lead, cadmium, and more have been found in dairy and in animals raised for human consumption.[3–8] Remember, breast milk is a fatty substance that reflects its environment, and considering the ubiquity of pollutants in the current day, they are most certainly present in agricultural sites. Cows—just like any large animal—bioaccumulate toxins in the environment such as persistent organic pollutants (POPs). These are dangerous pollutants that are extremely difficult to remove from the ecosystem.[9] Dioxins are a class of POPs that have been demonstrated to cause cancer in humans as well as harm to the nervous, endocrine, and reproductive systems.[10] Ninety percent of dioxin exposure to people comes through the foods they eat and dairy products are one of the most dioxin-contaminated foods.[10] Consuming dairy has become increasingly risky over the centuries due to the fact that we have adulterated it and our environment to the extent that we have.

Many consumers consider dairy foods to be products of a benign and natural "farm-to-table" process. The timeline between the birth of a cow and the carton of milk in the refrigerator, however, involves a number of steps in which contamination may occur.

Dairy operations tend to be non-sterile environments,[11,12] crawling with pathogens.[13,14] Due to these dangerous living conditions which threaten the health of livestock and diminish their yield, dairy cows are routinely injected with various hormones, vaccines, and prophylactic antibiotics—preemptive administration to defend against potential infection.[15,16] Additionally, many dairy cows are exposed to POPs.[17] POPs present in the soil are retained in the fatty tissues of dairy cows as well as their milk.[17] Not only POPs,[17] but antibiotics[18,19] and hormones[20]—both natural and supplemental—are carried through cow's milk. When a person consumes the milk from a cow, they are typically ingesting these contaminants as well.[17–19]

In addition to ingesting toxins from the environment, dairy cows often consume additional toxins in their feed. Under current livestock feed regulatory law, various rendered animal parts from dead, diseased animals and animal waste products are permitted in livestock feed.[19] Pathogenic contamination of animal feed is a cause for concern because humans are eating products from animals who may have been exposed to pathogens in their feed. While there are regulations around the presence of pathogenic organisms, drug residues, and pesticide residues in feed, these laws are weakly enforced.[19]

Once a cow is milked, a multi-stage transportation process ensues, presenting a number of potential points of contamination as that lactation travels from the teat to a consumer's refrigerator; the first of which is the milking process itself.[21] Cows live among their own feces, which can easily find its way into the milk.[22] Transportation and storage of milk present additional opportunities for contamination.[23] Pasteurization is a standard purification process undergone to kill unwanted microbes.[24] Inflammatory endotoxins produced by these organisms in the milk, however, can make it through the pasteurization process and be carried to the consumer.[25,26]

Along with the issues of contamination in cow's milk products, consuming these foods incurs a costly environmental burden. Dairy operations are reliant on fresh water and are also extremely land-intensive.[27] A large portion of America's dairy comes from concentrated animal feeding operations (CAFOs),[28] which occupy large pieces of land, erode topsoil,[27] and inhibit the land's ability to sequester carbon. These facilities also produce very large volumes of waste—much of which is inappropriately disposed of, but even industry standard disposal practices are associated with habitat degradation.[29] Runoff from CAFOs can include manure, nutrients, natural hormones, pharmaceuticals, pathogens and heavy metals, and has been demonstrated to dirty waterways and displace wildlife.[29] Currently over two-thirds of the world's agricultural land is used for maintaining livestock,[30] including beef and dairy cows. One-third of the world's land suffers desertification due, in large part, to deforestation, overgrazing, and poor agricultural practices.

The risk associated with dairy is a great burden on our bodies and environment. Its contaminants increase the risks of cancer, cardiovascular disease, diabetes, reproductive impairments, and other ailments.[4] The keeping of dairy cows places significant strains on our natural world and threatens habitat and biodiversity.[27,31]

## Racial Differences in Lactose Digestion and Disease Rates

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Lactose intolerance is not a disease, and it is not abnormal. In truth, lactose intolerance is a natural human (and mammalian) condition.[1] Sixty-five percent of the global human population is lactose intolerant, according to the National Institutes of Health.[2] The minority of those who do not experience lactose intolerance are considered lactase persistent, as they continue to produce the lactase enzyme that breaks down lactose consistently throughout their lives.

Only in European populations is lactase persistence common.[3] An evolutionary response to a lineage of dairy-containing diets, lactase persistence develops over the course of many generations and is a consequence of geographic and cultural influences. Researchers suggest the lactase persistence mutation coevolved alongside the cultural practice of dairying in some Caucasian populations.[3] Dairying—using the milks of non-human mammals—is only approximately five to six thousand years old.

In modern day, we see a high prevalence of lactose intolerance within racial groups that do not possess this extended history of dairy consumption.[2,4] According to the biological norm, humans—like other mammals—naturally lose the ability to produce the lactase enzyme after weaning from the breast.[1,4] Lactase production in the body drops steeply during early childhood and continues to decline throughout the lifespan.[5] Lactose intolerance is seen in roughly 50-80 percent of Hispanic Americans, 60-80 percent of African Americans and Ashkenazi Jews, 80-100 percent of Native Americans, and 95 percent of Asian Americans.[6] In older adults, African Americans are 3.6 times more likely to have developed lactose maldigestion and may experience a greater severity of symptoms compared to Caucasians.[7] For those who lack the lactase enzyme, the consumption of lactose in milk or other dairy foods can cause gastrointestinal distress including bloating, flatulence, and diarrhea.[2] Without the presence of lactase in the gut, the lactose largely passes through the small intestine into the colon where it is fermented by bacteria, leading to these uncomfortable gastrointestinal symptoms.[8]

Currently, the Dietary Guidelines for Americans (DGA) encourage three servings of dairy foods per day.[9] The recommendation does not just apply to Caucasian Americans, who are better able to digest lactose, but for all Americans, regardless of racial heritage or ability to digest lactose.

The primary reason such a heavy daily dosage of cow's milk is encouraged by the DGA is to address low dietary calcium consumption and to defend against osteoporosis. The efficacy of consuming cow's milk as a preventive strategy against osteoporosis, however, is unsubstantiated.[10–13] Additionally, osteoporosis is seen disproportionately among ethnic groups.

In fact, Caucasian women seem to be particularly susceptible to osteoporosis, especially when compared to African Americans.[14] Compared to Caucasian women, African American women are 45 percent less likely to get osteoporosis after adjusting for significant covariates such as weight and bone mineral density[15] and 50 percent less likely to fracture a hip.[14] On average, African American women have higher bone mineral density,[16] greater peak bone mass, favorable femoral geometry,[17] slower bone loss,[18] and lower urinary calcium excretion[19] than Caucasian women. For all of these reasons, African American women appear to be genetically protected against osteoporosis, but this is not reflected in the Dietary Guidelines. To highlight this point, postmenopausal African American women actually consume less calcium than postmenopausal Caucasian women,[20] yet, they still have lower rates of osteoporosis and bone fracture. Despite these differences, the recommendation to consume three servings of dairy per day is directed toward African American and white women alike.

Despite decades of the USDA and HHS encouraging dairy consumption at the behest of the dairy lobby, milk's ability to protect against osteoporosis is questionable at best. A 2011 meta-analysis of prospective cohort studies found no association between milk consumption and hip fracture risk in women.[10] While drinking milk during teenage years does contribute to peak bone mass, ingestion during adolescence does not decrease one's risk of hip fracture later in life.[11] Perhaps surprisingly, some studies have found that higher milk consumption increases hip fracture risk in women[12] and men.[11]

The idea that the calcium from milk builds strong bones is not based in science.[10-13] All infant mammals consume their mother's breast milk, but for a very short period of time. While there is certainly some skeletal development that occurs during the nursing period, the milk these animals consume is likely more incumbent in overall growth, the establishment of the immune system, and other areas of physiological development. Far greater development of the skeleton occurs during adolescence,[21,22] rather than the period of nursing. The point being that the calcium which supports an animal's bones for the vast majority of life comes from their typical diet, not from their mother's milk. Animals in nature are not drinking milk of any kind throughout adulthood, and neither did humans until a few thousand years ago.[3] Infant mammals are primarily immobile while they are nursing—certainly the case for humans. The defenseless infant is a far cry from the idea held by many Americans of milk calcium and milk protein as being promoters of strength, vigor, and athletic prowess.

Dairy consumption is unnecessary, and there is evidence to suggest that it is harmful. This applies to all people—lactose intolerant or not—and especially to people of color. Earlier sections of this report have presented the relationship between cow's milk and other animal products to chronic diseases such as type 1 diabetes,[23] asthma,[24] Parkinson's,[25] and hormone-dependent cancers.[26–30] These hormone-dependent cancers—cancer of the breast, ovary, prostate, and testicle—are particularly deadly and are understandably worrisome. As we saw earlier in the example of osteoporosis, susceptibility to a particular disease may vary between racial groups.[31] People of color tend to be disproportionately affected by a number of chronic diseases[32]—hypertension, stroke, cancer, obesity, diabetes, and coronary heart disease—and are less likely to receive proper medical treatment.[33] In light of these research findings, the recommendations for Americans to continue to consume dairy products appears to be more related to government subsidies, marketing campaigns, and a desire to preserve income for dairy producers than evidence-based guidelines designed to ensure optimal health.

Paralleling ineffective recommendations on dairy and calcium, the DGA falls short in presenting a viable nutrition strategy to address these chronic diseases.[34] Dairy products are encouraged despite knowledge of their harmful nature. Further, people of color may lack adequate access to nutritious food, putting them at greater dependence on the government.[35] The DGA forms the basis for federal and private food assistance programs which feature a prevalence of animal foods—namely dairy.[34] Reasonably, a well-intentioned, health-conscious American would look to the Guidelines for nutrition information. In effect, minority populations end up consuming more of the foods that cause disease—diseases for which they are already at increased risk.[32]

## Closing Note

For the past century, cow's milk has been positioned as essential to health, vitality, strength, and fitness. This white fluid has steadily seeped into the hearts and minds of Americans—but at what cost?

Why is it that so many of us consume cow's milk? What value do milk and dairy foods provide to athletes, and what is their association with health?

This report has presented an inquiry into the true characteristics of dairy—both its perceived benefits and its glossed-over detriments. Through inquisitive scientific and socioeconomic lenses, this report has examined the ubiquity of cow's milk among Americans and the effects it has on their bodies.

Through careful investigation, the report has found that the overwhelming prevalence of dairy foods in sports nutrition and the consequent perceived role in healthy dietary patterns does not result from an objective understanding of current nutrition science. Rather than impartial scientists and dietitians, the advice of political and economic actors have shaped consumers' opinions of cow's milk and have augmented its access. Industry players, in tandem with government officials, have and continue to promote the sale of cow's milk by way of government policy, subsidies, industry-funded science, marketing, and sponsorships, often exploiting an association between cow's milk and high-profile athletes—a connection that was intentionally manufactured and is now taken for granted.

The report has highlighted the implications of drinking cow's milk as an athlete and as a non-athlete. Cow's milk consumption has been linked to a number of chronic diseases such as hormone-dependent cancers, type 1 diabetes, Parkinson's disease, and infertility, among others. For athletes, there is little in the way of evidence to support the notion that cow's milk is a performance food. Mechanistically, the constituents of cow's milk may impair athletic performance and recovery by reducing blood flow and tissue oxygenation, exacerbating respiratory symptoms, causing gastrointestinal distress, and degrading bone integrity.

Beyond athletes, dairy products have long been marketed to the American public as an essential food for both children and adults. Americans believe dairy builds strong bones, that it is instrumental in childhood development, and that it serves as the single, indispensable source of calcium in their diets. These associations have everything to do with intentional efforts on the part of dairy processors, advocates, and profiteers to condition the minds of Americans around these ideas.

The collection of multi-billion-dollar efforts made throughout the century by both the dairy industry and the US government has gone past the point of marketing, toward manipulation. Consumers deserve to know what goes into their bodies, but they cannot make informed decisions to protect their health when they are provided with one-sided information. Due to the prevalence of pro-dairy literature and advertisements, consumers may not understand what they are buying when they place that gallon of milk on the checkout stand. This report was intended to empower consumers with the knowledge of what is really in their glass or in their fridge and to offer a viable, nutritious alternative to dairy.

# References

## Introduction (3)


1. Sewell, C. Removing the Meat Subsidy: Our Cognitive Dissonance Around Animal Agriculture. Columbia University SIPA Journal of International Affairs. https://jia.sipa.columbia.edu/removing-meat-subsidy-our-cognitive-dissonance-around-animal-agriculture. Published February 11, 2020. Accessed June 1, 2020.
2. Definition & Facts for Lactose Intolerance. National Institute of Diabetes and Digestive and Kidney Diseases. https://www.niddk.nih.gov/health-information/digestive-diseases/lactose-intolerance/definition-facts. Published February 2018. Accessed June 1, 2020.
3. Papacosta E, Nassis GP, Gleeson M. Effects of acute postexercise chocolate milk consumption during intensive judo training on the recovery of salivary hormones, salivary SIgA, mood state, muscle soreness, and judo-related performance. Appl Physiol Nutr Metab. 2015;40(11):1116-1122. doi:10.1139/apnm-2015-0243
4. Willett WC, Ludwig DS. Milk and Health. N Engl J Med. 2020;382(7):644-654. doi:10.1056/NEJMra1903547


# The Ubiquity of Cow's Milk in Sports

## A Historical Perspective on Cow's Milk and Athletes (4)


1. Early Developments in the American Dairy Industry. U.S Department of Agriculture, National Agriculture Library, Special Collections. https://specialcollections.nal.usda.gov/dairy-exhibit. Accessed April 3, 2020.
2. Vox. How Big Government Helps Big Dairy Sell Milk. YouTube. https://www.youtube.com/watch?time_continue=4&v=XRCj8LVTRyA. May 2, 2016. Accessed January 20, 2020.
3. Shelton T. *Milk for Lunch: The History and Health of Milk in School Lunches [honor's scholar thesis]*. Greencastle, Indiana: DePauw University; 2018. https://scholarship.depauw.edu/cgi/viewcontent.cgi?article=1094&context=studentresearch.
4. Ralston K, Newman C, Clauson A, Guthrie J, Buzby JC. *The National School Lunch Program Background, Trends, and Issues*. Washington, DC: U.S. Department of Agriculture, Economic Research Service; 2008. Economic Research Report Number 61.
5. *Richard B. Russell National School Lunch Act*. Washington, DC: U.S. House Committee on Financial Services; 2019. 42 U.S.C. § 1751.
6. Historical Timeline – Milk. ProCon. https://milk.procon.org/historical-timeline. Accessed January 20, 2020.
7. Blakemore E. How the U.S. Ended Up with Warehouses Full of "Government Cheese." HISTORY. https://www.history.com/news/government-cheese-dairy-farmers-reagan. Accessed January 20, 2020.
8. King SS. Warehouses Bulge with Surplus Cheese, Butter and Dried Milk. The New York Times. https://www.nytimes.com/1982/07/06/us/warehouses-bulge-with-surplus-cheese-butter-and-dried-milk.html. Published July 6, 1982. Accessed January 20, 2020.
9. National Dairy Promotion & Research Board. U.S. Department of Agriculture, Agricultural Marketing Service. https://www.ams.usda.gov/rules-regulations/research-promotion/dairy. Accessed January 20, 2020.
10. Philpott T. The Real Reason Pizza Hut Just Rolled Out the Extra-cheesy. Mother Jones. https://www.motherjones.com/food/2018/03/dairy-glut-pizza-hut-trump-dominos-checkoff-taco-bell. Published March 8, 2018. Accessed January 20, 2020.
11. Dickrell J. New Starbucks Drinks Use Dairy Protein. AgWeb. https://www.agweb.com/article/New_Starbucks_Drinks_Use_Dairy_Protein__204990. Published August 29, 2008. Accessed January 20, 2020.
12. Wallin S. Checkoff Scientists Help McDonald's USA Create Dairy-focused Offerings. U.S. Dairy. https://www.usdairy.com/media/press-releases/checkoff-scientists-help-mcdonalds-usa-create-dairy-focused-offerings. Published March 23, 2018. Accessed January 20, 2020.
13. Thousands of Student Athletes Refuel with Chocolate Milk. American Dairy Association North East. https://www.americandairy.com/news-and-events/news/news/thousands-of-student-athletes-refuel-with-chocolate-milk.stml. Published March 28, 2019. Accessed April 4, 2020.
14. *Report to Congress on the Dairy Promotion and Research Program and the Fluid Milk Processor Promotion Program 2015 Program Activities*. Washington, DC: U.S. Department of Agriculture; 2017. https://www.ams.usda.gov/sites/default/files/media/2015%20Dairy%20Report%20To%20Congress.pdf. Accessed January 20, 2020.
15. Sponsorship Success: Built With Chocolate Milk. IEG Sponsorship Report. http://www.sponsorship.com/IEGSR/2017/07/10/Milk-Companies-Increase-Sponsorship-Activity/Sponsorship-Success--Built-With-Chocolate-Milk.aspx. Published July 10, 2017. Accessed January 20, 2020.
16. Veri MJ. Got athletes? The use of male athlete celebrity endorsers in early twentieth-century dairy-industry promotions. J Sport Hist. 2016;43(3):290. doi:10.5406/jsporthistory.43.3.0290
17. Ahmed M. Olympics Takes Gold With $3bn Mengniu Dairy-Coca-Cola Deal. Financial Times. https://www.ft.com/content/11568a4a-95a7-11e9-9573-ee5cbb98ed36. Published June 24, 2019. Accessed April 4, 2020.
18. Built With Chocolate Milk. U.S. Tennis Champion Sloane Stephens Takes Center Court In 'BUILT WITH CHOCOLATE MILK'™ Campaign: Stephens Shares Her Secret to Bouncing Back in New Marketing Campaign. Cision PR Newswire. https://www.prnewswire.com/news-releases/us-tennis-champion-sloane-stephens-takes-center-court-in-built-with-chocolate-milk-campaign-300615560.html. Published March 19, 2018. Accessed April 4, 2020.
19. U.S. Department of Agriculture 2019 Budget. MilkPEP https://www.milkpep.org/wp-content/uploads/2018/11/Pages-from-USDA-2019-Budget-Approval-AUG-2018.pdf. Published August 21, 2018. Accessed April 4, 2020
20. Potter J, Fuller B. The effectiveness of chocolate milk as a post-climbing recovery aid. J Sports Med Phys Fitness. 2015 Dec;55(12):1438-44.
21. Upshaw AU, Wong TS, Bandegan A, Lemon PW. Cycling time trial performance 4 hours after glycogen-lowering exercise is similarly enhanced by recovery nondairy chocolate beverages versus chocolate milk. Int J Sport Nutr Exerc Metab. 2016;26(1):65-70. doi:10.1123/ijsnem.2015-0056
22. Pritchett, K. Acute effects of chocolate milk and a commercial recovery beverage on postexercise recovery indices and endurance cycling performance. Appl Physiol Nutr Metab 2009;34(6):1017-1022.


## Chocolate Milk: The Ultimate Recovery Beverage? (7)


1. Growth Charts for Dairy Heifers. Penn State Extension. https://extension.psu.edu/growth-charts-for-dairy-heifers. Updated July 28, 2017. Accessed December 29, 2019.
2. FoodData Central. Milk, Whole, 3.25% Milkfat, with Added Vitamin D. U.S. Department of Agriculture, Agricultural Research Service. https://fdc.nal.usda.gov/fdc-app.html#/food-details/746782/nutrients. Published December 16, 2019. Accessed February 11, 2020.
3. Breastmilk Composition. Australian Breastfeeding Association. https://www.breastfeeding.asn.au/bfinfo/breastmilk-composition. Published July 2017. Accessed February 11, 2020.
4. Differences Between Human Breast Milk and Cow Milk. TMR International Hospital. http://tmrinternational.org/why-you-should-not-give-your-baby-cow-or-any-animal-milk. Published August 7, 2019. Accessed February 11, 2020.
5. Backed By Science. Built With Chocolate Milk. https://builtwithchocolatemilk.com/science. Accessed December 5, 2019.
6. Peake JM. Muscle damage and inflammation during recovery from exercise. J Appl Physiol (1985). 2017;122(3):559-570. doi:10.1152/japplphysiol.00971.2016
7. Powers SK, Jackson MJ. Exercise-induced oxidative stress: cellular mechanisms and impact on muscle force production. Physiol Rev. 2008;88(4):1243-1276. doi:10.1152/physrev.00031.2007
8. *Physical Activity Guidelines for Americans, 2nd edition*. Washington, DC: U.S. Department of Health and Human Services; 2018.
9. Phaniendra A. Free radicals: properties, sources, targets, and their implication in various diseases. Indian J Clin Biochem. 2015;30(1):11-26. doi:10.1007/s12291-014-0446-0
10. Powers SK, Talbert EE, Adhihetty PJ. Reactive oxygen and nitrogen species as intracellular signals in skeletal muscle. J Physiol. 2011;589(Pt 9):2129-2138. doi:10.1113/jphysiol.2010.201327
11. Gomez-Cabrera MC, Domenech E, Vina J. Moderate exercise is an antioxidant: upregulation of antioxidant genes by training. Free Radic Biol Med. 2008;44(2):126-doi:10.1016/j.freeradbiomed.2007.02.001
12. Rauma AL, Mykkanen H. Antioxidant status in vegetarians versus omnivores. Nutrition. 2000;16(2):111-119. doi:10.1016/s0899-9007(99)00267-1
13. Thomas DT, Erdman KA, Burke LM. Position of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine: nutrition and athletic performance. J Acad Nutr Diet. 2016;116(3):501-528. doi:10.1016/j.jand.2015.12.006
14. Vitale K, Getzin A. Nutrition and supplement update for the endurance athlete: review and recommendations. Nutrients. 2019;11(6):1289. doi:10.3390/nu11061289

15. Howarth KR, Moreau NA, Phillips SM, Gibala MJ. Coingestion of protein with carbohydrate during recovery from endurance exercise stimulates skeletal muscle protein synthesis in humans. J Appl Physiol (1985). 2009;106(4):1394-1402. doi:10.1152/japplphysiol.90333.2008
16. Berardi JM, Price TB, Noreen EE, Lemon PWR. Postexercise muscle glycogen recovery enhanced with a carbohydrate-protein supplement. Med Sci Sports Exerc. 2006;38(6):1106-1113. doi:10.1249/01.mss.0000222826.49358.f3
17. Tang JE, Moore DR, Kujbida GW, Tarnopolsky MA, Phillips SM. Ingestion of whey hydrolysate, casein, or soy protein isolate: effects on mixed muscle protein synthesis at rest and following resistance exercise in young men. J Appl Physiol (1985). 2009;107(3):987-992. doi:10.1152/japplphysiol.00076.2009
18. Burd NA, Tang JE, Moore DR, Phillips SM. Exercise training and protein metabolism: influences of contraction, protein intake, and sex-based differences. J Appl Physiol (1985). 2009;106(5):1692-1701. doi:10.1152/japplphysiol.91351.2008
19. Jager R, Kerksick CM, Campbell BI, et al. International society of sports nutrition position stand: protein and exercise. J Int Soc Sports Nutr. 2017;14(1):20. doi:10.1186/s12970-017-0177-8
20. Kerksick CM, Arent S, Schoenfeld BJ, et al. International society of sports nutrition position stand: nutrient timing. J Int Soc Sports Nutr. 2017;14(1):33. doi:10.1186/s12970-017-0189-4
21. Kawamura T, Muraoka I. Exercise-induced oxidative stress and the effects of antioxidant intake from a physiological viewpoint. Antioxidants. 2018;7(9). doi:10.3390/antiox7090119
22. Barnard ND, Goldman DM, Loomis JF, et al. Plant-based diets for cardiovascular safety and performance in endurance sports. Nutrients. 2019;11(1). doi:10.3390/nu11010130
23. Maughan RJ, Shirreffs SM. Recovery from prolonged exercise: restoration of water and electrolyte balance. J Sports Sci. 1997;15(3):297-303. doi:10.1080/026404197367308
24. Vogel RA, Corretti MC, Plotnick GD. Effect of a single high-fat meal on endothelial function in healthy subjects. Am J Cardiol. 1997;79(3):350-354. doi:10.1016/s0002-9149(96)00760-6
25. *2015 – 2020 Dietary Guidelines for Americans, 8th Edition*. Washington, DC: U.S. Department of Health and Human Services and U.S. Department of Agriculture; 2015.
26. FoodData Central. Lowfat Chocolate Milk. U.S. Department Agriculture, Agricultural Research Service https://fdc.nal.usda.gov/fdc-app.html#/food-details/525708/nutrients. Published April 1, 2019. Accessed April 9, 2020.
27. Haug A, Hostmark AT, Harstad OM. Bovine milk in human nutrition – a review. Lipids Health Dis. 2007;6:25. doi:10.1186/1476-511X-6-25
28. Sawka MN, Burke LM, et al. American College of Sports Medicine position stand. Exercise and fluid replacement. American College of Sports Medicine. Med Sci Sports Exerc. 2007;39(2):377-390. doi:10.1249/mss.0b013e31802ca597
29. Maughan RJ, Shirreffs SM. Dehydration and rehydration in competitive sport. Scand J Med Sci Sports. 2010;20 Suppl 3:40-47. doi:10.1111/j.1600-0838.2010.01207.x
30. Malekinejad H, Rezabakhsh A. Hormones in dairy foods and their impact on public health - a narrative review article. Iran J Public Health. 2015;44(6):742-758.
31. Kroenke CH, Kwan ML, Sweeney C, Castillo A, Caan BJ. High- and low-fat dairy intake, recurrence, and mortality after breast cancer diagnosis. J Natl Cancer Inst. 2013;105(9):616-623. doi:10.1093/jnci/djt027
32. Ganmaa D, Cui X, Feskanich D, Hankinson SE, Willett WC. Milk, dairy intake and risk of endometrial cancer: a 26-year follow-up. Int J Cancer. 2012;130(11):2664-2671. doi:10.1002/ijc.26265
33. Kim K, Wactawski-Wende J, Michels KA, et al. Dairy food intake is associated with reproductive hormones and sporadic anovulation among healthy premenopausal women. J Nutr. 2017;147(2):218-226. doi:10.3945/jn.116.241521
34. Souter I, Chiu YH, Batsis M, et al. The association of protein intake (amount and type) with ovarian antral follicle counts among infertile women: results from the EARTH prospective study cohort. BJOG. 2017;124(10):1547-1555. doi:10.1111/1471-0528.14630
35. Carlsen MH, Halvorsen BL, Holte K, et al. The total antioxidant content of more than 3100 foods, beverages, spices, herbs and supplements used worldwide. Nutr J. 2010;9:3. doi:10.1186/1475-2891-9-3
36. Szeto Y. Effects of a long-term vegetarian diet on biomarkers of antioxidant status and cardiovascular disease risk. Nutrition. 2004;20(10):863-866. doi:10.1016/j.nut.2004.06.006
37. Michaelsson K, Wolk A, Melhus H, Byberg L. Milk, fruit and vegetable, and total antioxidant intakes in relation to mortality rates: cohort studies in women and men. Am J Epidemiol. 2017;185(5):345-361. doi:10.1093/aje/kww124
38. Hruby A, Jacques PF. Dietary protein and changes in biomarkers of inflammation and oxidative stress in the Framingham Heart Study offspring cohort. Curr Dev Nutr. 2019;3(5):nzz019. doi:10.1093/cdn/nzz019
39. Fuhrman J, Ferreri DM. Fueling the vegetarian (vegan) athlete. Curr Sports Med Rep. 2010;9(4):233-241. doi:10.1249/JSR.0b013e3181e93a6f
40. Rauma AL, Torronen R, Hanninen O, Verhagen H, Mykkanen H. Antioxidant status in long-term adherents to a strict uncooked vegan diet. Am J Clin Nutr. 1995;62(6):1221-1227. doi:10.1093/ajcn/62.6.1221
41. Kahleova H, Matoulek M, Malinska H, et al. Vegetarian diet improves insulin resistance and oxidative stress markers more than conventional diet in subjects with type 2 diabetes. Diabet Med J Br Diabet Assoc. 2011;28(5):549-559. doi:10.1111/j.1464-5491.2010.03209.x
42. Wang X, Ouyang Y, Liu J, et al. Fruit and vegetable consumption and mortality from all causes, cardiovascular disease, and cancer: systematic review and dose-response meta-analysis of prospective cohort studies. BMJ. 2014;349:g4490. doi:10.1136/bmj.g4490
43. Zhang X, Shu X-O, Xiang Y-B, et al. Cruciferous vegetable consumption is associated with a reduced risk of total and cardiovascular disease mortality. Am J Clin Nutr. 2011;94(1):240-246. doi:10.3945/ajcn.110.009340
44. He FJ, Nowson CA, MacGregor GA. Fruit and vegetable consumption and stroke: meta-analysis of cohort studies. Lancet. 2006;367(9507):320-326. doi:10.1016/S0140-6736(06)68069-0
45. Giacosa A, Barale R, Bavaresco L, et al. Cancer prevention in Europe: the Mediterranean diet as a protective choice. Eur J Cancer Prev. 2013;22(1):90-95. doi:10.1097/CEJ.0b013e328354d2d7

## Built With Chocolate Milk and Industry-Funded Studies (12)

1. Backed By Science. Built With Chocolate Milk. https://builtwithchocolatemilk.com/science. Accessed December 5, 2019.
2. Karfonta K, Lunn W, Colletto M, Anderson J, Rodriguez N. Chocolate milk and glycogen replenishment after endurance exercise in moderately trained males. Med Sci Sports Exerc. 2010;42(5):86. doi:10.1249/01.MSS.0000385622.48600.1e
3. Gilson SF, Saunders MJ, Moran CW, Moore RW, Womack CJ, Todd MK. Effects of chocolate milk consumption on markers of muscle recovery following soccer training: a randomized cross-over study. J Int Soc Sports Nutr. 2010;7:19. doi:10.1186/1550-2783-7-19
4. Shirreffs SM, Watson P, Maughan RJ. Milk as an effective post-exercise rehydration drink. Br J Nutr. 2007;98(1):173-180. doi:10.1017/S0007114507695543
5. Watson P, Love TD, Maughan RJ, Shirreffs SM. A comparison of the effects of milk and a carbohydrate-electrolyte drink on the restoration of fluid balance and exercise capacity in a hot, humid environment. Eur J Appl Physiol. 2008;104(4):633-642. doi:10.1007/s00421-008-0809-4
6. Seery S, Jakeman P. A metered intake of milk following exercise and thermal dehydration restores whole-body net fluid balance better than a carbohydrate-electrolyte solution or water in healthy young men. Br J Nutr. 2016;116(6):1013-1021. doi:10.1017/S0007114516002907
7. Josse AR, Tang JE, Tarnopolsky MA, Phillips SM. Body composition and strength changes in women with milk and resistance exercise. Med Sci Sports Exerc. 2010;42(6):1122-1130. doi:10.1249/MSS.0b013e3181c854f6
8. Cockburn E, Hayes PR, French DN, Stevenson E, St Clair Gibson A. Acute milk-based protein-CHO supplementation attenuates exercise-induced muscle damage. Appl Physiol Nutr Metab. 2008;33(4):775-783. doi:10.1139/H08-057
9. Cockburn E, Stevenson E, Hayes PR, Robson-Ansley P, Howatson G. Effect of milk-based carbohydrate-protein supplement timing on the attenuation of exercise-induced muscle damage. Appl Physiol Nutr Metab. 2010;35(3):270-277. doi:10.1139/H10-017
10. Karp JR, Johnston JD, Tecklenburg S, Mickleborough TD, Fly AD, Stager JM. Chocolate milk as a post-exercise recovery aid. Int J Sport Nutr Exerc Metab. 2006;16(1):78-91. doi:10.1123/ijsnem.16.1.78
11. Thomas K, Morris P, Stevenson E. Improved endurance capacity following chocolate milk consumption compared with 2 commercially available sport drinks. Appl Physiol Nutr Metab. 2009;34(1):78-82. doi:10.1139/H08-137
12. Ferguson-Stegall L, McCleave E, Ding Z, et al. Aerobic exercise training adaptations are increased by postexercise carbohydrate-protein supplementation. J Nutr Metab. 2011;2011:623182. doi:10.1155/2011/623182
13. Ferguson-Stegall L, McCleave EL, Ding Z, et al. Postexercise carbohydrate-protein supplementation improves subsequent exercise performance and intracellular signaling for protein synthesis. J Strength Cond Res. 2011;25(5):1210-1224. doi:10.1519/JSC.0b013e318212db21
14. Potter J, Fuller B. The effectiveness of chocolate milk as a post-climbing recovery aid. J Sports Med Phys Fitness. 2015;55(12):1438-1444.
15. Maughan RJ, Watson P, Cordery PA, et al. A randomized trial to assess the potential of different beverages to affect hydration status: development of a beverage hydration index. Am J Clin Nutr. 2016;103(3):717-723. doi:10.3945/ajcn.115.114769
16. Hartman JW, Tang JE, Wilkinson SB, et al. Consumption of fat-free fluid milk after resistance exercise promotes greater lean mass accretion than does consumption of soy or carbohydrate in young, novice, male weightlifters. Am J Clin Nutr. 2007;86(2):373-381. doi:10.1093/ajcn/86.2.373
17. Lunn WR, Pasiakos SM, Colletto MR, et al. Chocolate milk and endurance exercise recovery: protein balance, glycogen, and performance. Med Sci Sports Exerc. 2012;44(4):682-691. doi:10.1249/MSS.0b013e3182364162

18. Lunn W, Colletto M, Karfonta K, Anderson J, Pasiakos S, Ferrando A, Wolfe R, Rodriguez N. Chocolate milk consumption following endurance exercise affects skeletal muscle protein fractional synthetic rate and intracellular signaling. Med Sci Sport Exer. 2010;42(5):64. doi:10.1249/01.MSS.0000385215.55902.d5
19. Stager JM, Brammer CL, Sossong T, Kojima K, Spanbauer D, Grand K, Wright BV. Supplemental Recovery Nutrition affects Swim Performance following Glycogen Depleting Exercise. Presented at: ACSM Annual Meeting 2014; May 2014; Orlando, Florida.
20. Nestle M. *Food Politics: How the Food Industry Influences Nutrition and Health.* Oakland, California: University of California Press; 2002.
21. Belluz J. Nutrition Research Is Deeply Biased by Food Companies. A New Book Explains Why. Vox. https://www.vox.com/2018/10/31/18037756/superfoods-food-science-marion-nestle-book. Published October 31, 2018. Accessed October 31, 2019.
22. The Benefits of Chocolate Milk After a Workout. Built With Chocolate Milk. https://builtwithchocolatemilk.com/science/workout-recovery. Accessed November 6, 2019.
23. Thomas DT, Erdman KA, Burke LM. Position of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine: nutrition and athletic performance. J Acad Nutr Diet. 2016;116(3):501-528. doi:10.1016/j.jand.2015.12.006
24. Phillips SM, Van Loon LJC. Dietary protein for athletes: from requirements to optimum adaptation. J Sports Sci. 2011;29 Suppl 1:S29-38. doi:10.1080/02640414.2011.619204
25. Børsheim E. Effect of carbohydrate intake on net muscle protein synthesis during recovery from resistance exercise. J Appl Physiol. 2004;96(2):674-678. doi:10.1152/japplphysiol.00333.2003
26. FoodData Central. Chocolate Milk. U.S. Department of Agriculture, Agricultural Research Service. https://fdc.nal.usda.gov/fdc-app.html#/food-details/1017269/nutrients. Published June 26, 2020. Accessed August 21, 2020.
27. Amiri M, Ghiasvand R, Kaviani M, Forbes SC, Salehi-Abargouei A. Chocolate milk for recovery from exercise: a systematic review and meta-analysis of controlled clinical trials. Eur J Clin Nutr. 2019;73(6):835-849. doi:10.1038/s41430-018-0187-x

## Clinical Perspectives on Athletes and Cow's Milk Consumption

### Exercise, Hormones and Women's Health (15)

1. Janse de Jonge XA. Effects of the menstrual cycle on exercise performance. Sports Med. 2003;33(11):833-851. doi:10.2165/00007256-200333110-00004
2. Menstrually Related Mood Disorders. Center for Women's Mood Disorders, UNC School of Medicine. https://www.med.unc.edu/psych/wmd/mood-disorders/menstrually-related. Accessed June 18, 2020.
3. Barnard ND, Scialli AR, Hurlock D, Bertron P. Diet and sex-hormone binding globulin, dysmenorrhea, and premenstrual symptoms. Obstet Gynecol. 2000;95(2):245-250. doi:10.1016/s0029-7844(99)00525-6
4. Yonkers KA. Premenstrual syndrome. Lancet. 2008;371(9619): 1200–1210. doi:10.1016/S0140-6736(08)60527-9
5. Goldin BR. Estrogen excretion patterns and plasma levels in vegetarian and omnivorous women. N Engl J Med. 1982;307(25):1542-1547. doi:10.1056/nejm198212163072502
6. Maruyama K, Oshima T, Ohyama K. Exposure to exogenous estrogen through intake of commercial milk produced from pregnant cows. Pediatr Int 2010;52(1):33-38. doi:10.1111/j.1442-200X.2009.02890.x
7. Hartmann S, Lacorn M, Steinhart H. Natural occurrence of steroid hormones in food. Food Chem. 1998;62(1):7-20. doi:10.1016/S0308-8146(97)00150-7
8. Nagata C. Fat intake is associated with serum estrogen and androgen concentrations in postmenopausal Japanese women. J Nutr. 2005;135(12):2862-2865. doi:10.1093/jn/135.12.2862
9. Yamada K, Takeda T. Low proportion of dietary plant protein among athletes with premenstrual syndrome-related performance impairment. Tohoku J Exp Med. 2018;244(2):119-122. doi:10.1620/tjem.244.119
10. Keay N. Sports Endocrinology – What Does it Have to Do with Performance. British Journal of Sports Medicine. https://blogs.bmj.com/bjsm/2017/04/28/sports-endocrinology-performance. Published April 28, 2017. Accessed July 1, 2020.
11. Kroenke CH, Kwan ML, Sweeney C, Castillo A, Caan BJ. High- and low-fat dairy intake, recurrence, and mortality after breast cancer diagnosis. J Natl Cancer Inst. 2013;105(9):616-623. doi:10.1093/jnci/djt027
12. Ganmaa D, Cui X, Feskanich D, Hankinson SE, Willett WC. Milk, dairy intake and risk of endometrial cancer: a 26-year follow-up. Int J Cancer. 2012;130(11):2664-2671. doi:10.1002/ijc.26265
13. Kim K, Wactawski-Wende J, Michels KA, et al. Dairy food intake is associated with reproductive hormones and sporadic anovulation among healthy premenopausal women. J Nutr. 2017;147(2):218-226. doi:10.3945/jn.116.241521
14. Souter I, Chiu YH, Batsis M, et al. The association of protein intake (amount and type) with ovarian antral follicle counts among infertile women: results from the EARTH prospective study cohort. BJOG. 2017;124(10):1547-1555. doi:10.1111/1471-0528.14630
15. Barnard, ND. *Your Body in Balance: The New Science of Food, Hormones, and Health.* New York, NY: Grand Central Publishing; 2020.

### The Addictive Nature of Dairy Products (17)

1. Barnard, ND. *The Cheese Trap: How Breaking a Surprising Addiction Will Help You Lose Weight, Gain Energy, and Get Healthy.* New York, NY: Grand Central Publishing; 2017.
2. Schulte EM, Avena NM, Gearhardt AN. Which foods may be addictive? The roles of processing, fat content, and glycemic load. PLoS ONE. 2015;10(2). doi:10.1371/journal.pone.0117959
3. Teschemacher H, Koch G, Brantl V. Milk protein-derived opioid receptor ligands. Biopolymers. 1997;43(2):99-117. doi:10.1002/(SICI)1097-0282(1997)43:2<99::AID BIP3>3.0.CO;2-V
4. European Food Safety Authority (EFSA). Review of the potential health impact of ß-casomorphins and related peptides. EFSA J. 2009;231:1-107. doi:10.2903/j.efsa.2009.231r
5. Peuhkuri K, Sihvola N, Korpela R. Dietary proteins and food-related reward signals. Food Nutr Res. 2011;55. doi:10.3402/fnr.v55i0.5955
6. Huecker MR, Koutsothanasis GA, Abbasy MSU, et al. Heroin. In: StatPearls [Internet]. Treasure Island, FL: StatPearls Publishing; 2020. https://www.ncbi.nlm.nih.gov/books/NBK441876. Updated May 26, 2020. Accessed July 1, 2020.
7. Jarmołowska B, Sidor K, Iwan M, et al. Changes of beta-casomorphin content in human milk during lactation. Peptides. 2007;28(10):1982-1986. doi:10.1016/j.peptides.2007.08.002
8. Enjapoori AK, Kukuljan S, Dwyer KM, Sharp JA. In vivo endogenous proteolysis yielding beta-casein derived bioactive beta-casomorphin peptides in human breast milk for infant nutrition. Nutrition. 2019;57:259-267. doi:10.1016/j.nut.2018.05.011
9. Hurley SW, Johnson AK. The biopsychology of salt hunger and sodium deficiency. Pflugers Arch. 2015;467(3):445-456. doi:10.1007/s00424-014-1676-y
10. National Cancer Institute. Identification of Top Food Sources of Various Dietary Components. Epidemiology and Genomics Research Program. https://epi.grants.cancer.gov/diet/foodsources. Updated November 30, 2019. Accessed November 12, 2019
11. Standardization of Cheese Milk Composition. University of Guelph. https://www.uoguelph.ca/foodscience/book-page/standardization-cheese-milk-composition. Accessed November 11, 2019.
12. FoodData Central. Milk, Whole, 3.25% Milkfat, with Added Vitamin D. U.S. Department of Agriculture, Agricultural Research Service. https://fdc.nal.usda.gov/fdc-app.html#/food-details/746782/nutrients. Published December 16, 2019. Accessed February 11, 2020.
13. Gebhardt SE, Thomas RG. *Nutritive Value of Foods*. Washington, DC: U.S. Department of Agriculture, Agricultural Research Service; 2002. Home and Garden Bulletin Number 72.
14. Agarwal S, McCoy D, Graves W, Gerard PD, Clark S. Sodium content in retail cheddar, mozzarella, and process cheeses varies considerably in the United States. J Dairy Sci. 2011;94(3):1605-1615. doi:10.3168/jds.2010-3782

### Milk and Issues of Respiration (18)

1. Fitch KD. An overview of asthma and airway hyper-responsiveness in Olympic athletes. Br J Sports Med. 2012;46(6):413-416. doi:10.1136/bjsports-2011-090814
2. Arie S. What can we learn from asthma in elite athletes? BMJ. 2012;344:e2556. doi:10.1136/bmj.e2556
3. Flom JD, Sicherer SH. Epidemiology of cow's milk allergy. Nutrients. 2019;11(5). doi:10.3390/nu11051051
4. Haug A, Hostmark AT, Harstad OM. Bovine milk in human nutrition – a review. Lipids Health Dis. 2007;6:25. doi:10.1186/1476-511X-6-25
5. Milk allergy - Symptoms and Causes. Mayo Clinic. https://www.mayoclinic.org/diseases-conditions/milk-allergy/symptoms-causes/syc-20375101. Accessed March 25, 2020.

6. Wang J, Visness CM, Sampson HA. Food allergen sensitization in inner-city children with asthma. J Allergy Clin Immunol. 2005;115(5):1076-1080. doi:10.1016/j.jaci.2005.02.014
7. Kewalramani A, Bollinger ME. The impact of food allergy on asthma. J Asthma Allergy. 2010;3:65-74. doi:10.2147/jaa.s11789
8. Patel S, Custovic A, Smith JA, Simpson A, Kerry G, Murray CS. Cross-sectional association of dietary patterns with asthma and atopic sensitization in childhood - in a cohort study. Pediatr Allergy Immunol. 2014;25(6):565-571. doi:10.1111/pai.12276
9. Wood LG, Garg ML, Gibson PG. A high-fat challenge increases airway inflammation and impairs bronchodilator recovery in asthma. J Allergy Clin Immunol. 2011;127(5):1133-1140. doi:10.1016/j.jaci.2011.01.036
10. Scott HA, Gibson PG, Garg ML, et al. Dietary restriction and exercise improve airway inflammation and clinical outcomes in overweight and obese asthma: a randomized trial. Clin Exp Allergy. 2013;43(1):36-49. doi:10.1111/cea.12004
11. National Cancer Institute. Identification of Top Food Sources of Various Dietary Components. Epidemiology and Genomics Research Program. https://epi.grants.cancer.gov/diet/foodsources. Updated November 30, 2019. Accessed November 12, 2019
12. Wood LG, Garg ML, Smart JM, Scott HA, Barker D, Gibson PG. Manipulating antioxidant intake in asthma: a randomized controlled trial. Am J Clin Nutr. 2012;96(3):534-543. doi:10.3945/ajcn.111.032623
13. Ellwood P, Asher MI, Garcia-Marcos L, et al. Do fast foods cause asthma, rhinoconjunctivitis and eczema? Global findings from the International Study of Asthma and Allergies in Childhood (ISAAC) Phase Three. Thorax. 2013;68(4):351-360. doi:10.1136/thoraxjnl-2012-202285

## Health Concerns and Performance Implications (19)

1. Feskanich D, Willett WC, Colditz GA. Calcium, vitamin D, milk consumption, and hip fractures: a prospective study among postmenopausal women. Am J Clin Nutr. 2003;77(2):504-511. doi:10.1093/ajcn/77.2.504
2. Lanou AJ. Should dairy be recommended as part of a healthy vegetarian diet? Counterpoint. Am J Clin Nutr. 2009;89(5). doi:10.3945/ajcn.2009.26736p
3. Lanou AJ, Berkow SE, Barnard ND. Calcium, dairy products, and bone health in children and young adults: a reevaluation of the evidence. Pediatrics. 2005;115(3):736-743. doi:10.1542/peds.2004-0548
4. Sonneville KR, Gordon CM, Kocher MS, Pierce LM, Ramappa A, Field AE. Vitamin d, calcium, and dairy intakes and stress fractures among female adolescents. Arch Pediatr Adolesc Med. 2012;166(7):595-600. doi:10.1001/archpediatrics.2012.5
5. Reid DM, New SA. Nutritional influences on bone mass. Proc Nutr Soc. 1997;56(3):977-987. doi:10.1079/pns19970103
6. Lin PH, Ginty F, Appel LJ, et al. The DASH diet and sodium reduction improve markers of bone turnover and calcium metabolism in adults. J Nutr. 2003;133(10):3130-3136. doi:10.1093/jn/133.10.3130
7. Qiu R, Cao W, Tian H, He J, Chen G, Chen Y. Greater intake of fruit and vegetables is associated with greater bone mineral density and lower osteoporosis risk in middle-aged and elderly adults. PLoS ONE. 2017;12(1). doi:10.1371/journal.pone.0168906
8. Benedetti MG, Furlini G, Zati A, Letizia Mauro G. The effectiveness of physical exercise on bone density in osteoporotic patients. Biomed Res Int. 2018;2018:4840531. doi:10.1155/2018/4840531
9. Going S, Lohman T, Houtkooper L, et al. Effects of exercise on bone mineral density in calcium-replete postmenopausal women with and without hormone replacement therapy. Osteoporos Int. 2003;14(8):637-643. doi:10.1007/s00198-003-1436-x
10. National Cancer Institute. Identification of Top Food Sources of Various Dietary Components. Epidemiology and Genomics Research Program. https://epi.grants.cancer.gov/diet/foodsources. Updated November 30, 2019. Accessed November 12, 2019
11. Vogel RA, Corretti MC, Plotnick GD. Effect of a single high-fat meal on endothelial function in healthy subjects. Am J Cardiol. 1997;79(3):350-354. doi:10.1016/s0002-9149(96)00760-6
12. Smith MM, Lucas AR, Hamlin RL, Devor ST. Associations among hemorheological factors and maximal oxygen consumption. Is there a role for blood viscosity in explaining athletic performance? Clin Hemorheol Microcirc. 2015;60(4):347-362. doi:10.3233/CH-131708
13. Barnard ND, Goldman DM, Loomis JF, et al. Plant-based diets for cardiovascular safety and performance in endurance sports. Nutrients. 2019;11(1). doi:10.3390/nu11010130
14. Li Y, Hruby A, Bernstein AM, et al. Saturated fats compared with unsaturated fats and sources of carbohydrates in relation to risk of coronary heart disease: a prospective cohort study. J Am Coll Cardiol. 2015;66(14):1538-1548. doi:10.1016/j.jacc.2015.07.055
15. Chen M, Li Y, Sun Q, et al. Dairy fat and risk of cardiovascular disease in 3 cohorts of US adults. Am J Clin Nutr. 2016;104(5):1209-1217. doi:10.3945/ajcn.116.134460
16. Ernst E, Pietsch L, Matrai A, Eisenberg J. Blood rheology in vegetarians. Br J Nutr. 1986;56(3):555-560. doi:10.1079/bjn19860136
17. Miller M, Beach V, Sorkin JD, et al. Comparative effects of three popular diets on lipids, endothelial function, and C-reactive protein during weight maintenance. J Am Diet Assoc. 2009;109(4):713-717. doi:10.1016/j.jada.2008.12.023
18. Nicholls SJ, Lundman P, Harmer JA, et al. Consumption of saturated fat impairs the anti-inflammatory properties of high-density lipoproteins and endothelial function. J Am Coll Cardiol. 2006;48(4):715-720. doi:10.1016/j.jacc.2006.04.080
19. Szeto YT, Kwok TC, Benzie IF. Effects of a long-term vegetarian diet on biomarkers of antioxidant status and cardiovascular disease risk. Nutrition. 2004;20(10):863-866. doi:10.1016/j.nut.2004.06.006
20. Ornish D, Brown SE, Scherwitz LW, et al. Can lifestyle changes reverse coronary heart disease? The Lifestyle Heart Trial. Lancet. 1990;336(8708):129-133. doi:10.1016/0140-6736(90)91656-u
21. Ornish D. Avoiding revascularization with lifestyle changes: The Multicenter Lifestyle Demonstration Project. Am J Cardiol. 1998;82(10B):72T-76T. doi:10.1016/s0002-9149(98)00744-9
22. Esselstyn CB, Gendy G, Doyle J, Golubic M, Roizen MF. A way to reverse CAD? J Fam Pract. 2014;63(7):356-364b.
23. Esselstyn CB, Ellis SG, Medendorp SV, Crowe TD. A strategy to arrest and reverse coronary artery disease: a 5-year longitudinal study of a single physician's practice. J Fam Pract. 1995;41(6):560-568.
24. Lactose Intolerance page: National Library of Medicine. Genetics Home Reference. https://ghr.nlm.nih.gov/condition/lactose-intolerance. Reviewed May 2010. Accessed November 15, 2019.
25. Swagerty DL Jr, Walling AD, Klein RM. Lactose intolerance [published correction appears in Am Fam Physician. 2003 Mar 15;67(6):1195]. Am Fam Physician. 2002;65(9):1845-1850.

## Athletes Seeking a Healthy Gut for Optimal Performance (21)

1. Holscher HD. Dietary fiber and prebiotics and the gastrointestinal microbiota. Gut Microbes. 2017;8(2):172-184. doi:10.1080/19490976.2017.1290756
2. Peters HP. Gastrointestinal symptoms in long-distance runners, cyclists, and triathletes: prevalence, medication, and etiology. Am J Gastroenterol. 1999 Jun;94(6):1570-81.doi:10.1111/j.1572-0241.1999.01147.x.
3. FoodData Central. Milk, Fluid, 1% Fat, Without Added Vitamin A and Vitamin D. U.S. Department Agriculture, Agricultural Research Service. https://fdc.nal.usda.gov/fdc-app.html#/food-details/173441/nutrients. Published April 1, 2019. Accessed June 18, 2020.
4. Swagerty DL Jr, Walling AD, Klein RM. Lactose intolerance [published correction appears in Am Fam Physician. 2003 Mar 15;67(6):1195]. Am Fam Physician. 2002;65(9):1845-1850.
5. Dasgupta A, Wahed A. Inborn Errors of Metabolism. In *Clinical Chemistry, Immunology and Laboratory Quality Control 1st Edition.* San Diego, CA: Elsevier; 2014:213-228. doi:10.1016/B978-0-12-407821-5.00012-7
6. Deng Y, Misselwitz B, Dai N, Fox M. Lactose intolerance in adults: biological mechanism and dietary management. Nutrients. 2015;7(9):8020-8035. doi:10.3390/nu7095380
7. Storhaug CL, Fosse SK, Fadnes LT. Country, regional, and global estimates for lactose malabsorption in adults: a systematic review and meta-analysis. Lancet Gastroenterol Hepatol. 2017;2(10):738-746. doi:10.1016/S2468-1253(17)30154-1
8. Wilder-Smith CH, Olesen SS, Materna A, Drewes AM. Fermentable sugar ingestion, gas production, and gastrointestinal and central nervous system symptoms in patients with functional disorders. Gastroenterology. 2018;155(4):1034-1044.e6. doi:10.1053/j.gastro.2018.07.013
9. Yang J, Deng Y, Chu H, et al. Prevalence and presentation of lactose intolerance and effects on dairy product intake in healthy subjects and patients with irritable bowel syndrome. Clin Gastroenterol Hepatol. 2013;11(3):262-268.e1. doi:10.1016/j.cgh.2012.11.034
10. Zhu Y, Zheng X, Cong Y, et al. Bloating and distention in irritable bowel syndrome: the role of gas production and visceral sensation after lactose ingestion in a population with lactase deficiency. Am J Gastroenterol. 2013;108(9):1516-1525. doi:10.1038/ajg.2013.198
11. Yang J, Fox M, Cong Y, et al. Lactose intolerance in irritable bowel syndrome patients with diarrhoea: the roles of anxiety, activation of the innate mucosal immune system and visceral sensitivity. Aliment Pharmacol Ther. 2014;39(3):302-311. doi:10.1111/apt.12582

12. Killian LA, Chapman-Novakofski KM, Lee SY. Questionnaire on irritable bowel syndrome and symptom management among endurance athletes is valid and reliable. Dig Dis Sci. 2018;63(12):3281-3289. doi:10.1007/s10620-018-5289-8
13. Datz T. Sulfur Amino Acid Restriction Diet Triggers New Blood Vessel Formation in Mice. Harvard T.H. Chan School of Public Health. https://www.hsph.harvard.edu/news/press-releases/sulfur-amino-acid-restriction-diet-blood-vessel-formation. Published March 23, 2018. Accessed April 6, 2020.
14. Yao CK, Rotbart A, Ou JZ, Kalantar-Zadeh K, Muir JG, Gibson PR. Modulation of colonic hydrogen sulfide production by diet and mesalazine utilizing a novel gas-profiling technology. Gut Microbes. 2018;9(6):510-522. doi:10.1080/19490976.2018.1451280
15. Chou CH, Selene J. *Hydrogen Sulfide : Human Health Aspects*. Geneva, Switzerland: World Health Organization; 2003. Concise International Chemical Assessment Document 53.
16. Wright R, Truelove SC. A controlled therapeutic trial of various diets in ulcerative colitis. Br Med J. 1965;2(5454):138-141. doi:10.1136/bmj.2.5454.138
17. Martin TD, Chan SSM, Hart AR. Environmental factors in the relapse and recurrence of inflammatory bowel disease: a review of the literature. Dig Dis Sci. 2015;60(5):1396-1405. doi:10.1007/s10620-014-3437-3
18. Thomas DT, Erdman KA, Burke LM. Position of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine: nutrition and athletic performance. J Acad Nutr Diet. 2016;116(3):501-528. doi:10.1016/j.jand.2015.12.006
19. Jäger R, Kerksick CM, Campbell BI, et al. International society of sports nutrition position stand: protein and exercise. J Int Soc Sports Nutr. 2017;14(1):20. doi:10.1186/s12970-017-0177-8
20. Vitale K, Getzin A. Nutrition and supplement update for the endurance athlete: review and recommendations. Nutrients. 2019;11(6):1289. doi:10.3390/nu11061289
21. Roediger WE, Moore J, Babidge W. Colonic sulfide in pathogenesis and treatment of ulcerative colitis. Dig Dis Sci. 1997;42(8):1571-1579.doi:10.1023/a:1018851723920
22. Smith EA, Macfarlane GT. Dissimilatory amino acid metabolism in human colonic bacteria. Anaerobe. 1997;3(5):327-337. doi:10.1006/anae.1997.0121
23. Macfarlane GT, Macfarlane S. Human colonic microbiota: ecology, physiology and metabolic potential of intestinal bacteria. Scand J Gastroenterol Suppl. 1997;222:3-9. doi:10.1080/00365521.1997.11720708
24. Visek WJ. Diet and cell growth modulation by ammonia. Am J Clin Nutr. 1978;31(10 Suppl):S216-S220. doi:10.1093/ajcn/31.10.S216
25. David LA, Maurice CF, Carmody RN, et al. Diet rapidly and reproducibly alters the human gut microbiome. Nature. 2014;505(7484):559-563. doi:10.1038/nature12820
26. Singh RK, Chang HW, Yan D, et al. Influence of diet on the gut microbiome and implications for human health. J Transl Med. 2017;15. doi:10.1186/s12967-017-1175-y
27. De Filippo C, Cavalieri D, Di Paola M, et al. Impact of diet in shaping gut microbiota revealed by a comparative study in children from Europe and rural Africa. Proc Natl Acad Sci U S A. 2010;107(33):14691-14696. doi:10.1073/pnas.1005963107
28. Schwabe RF, Jobin C. The microbiome and cancer. Nat Rev Cancer. 2013;13(11):800-812. doi:10.1038/nrc3610
29. Domínguez R, Cuenca E, Maté-Muñoz JL, et al. Effects of beetroot juice supplementation on cardiorespiratory endurance in athletes. A systematic review. Nutrients. 2017;9(1). doi:10.3390/nu9010043
30. Clifford T, Howatson G, West DJ, Stevenson EJ. The potential benefits of red beetroot supplementation in health and disease. Nutrients. 2015;7(4):2801-2822. doi:10.3390/nu7042801
31. Scalbert A, Johnson IT, Saltmarsh M. Polyphenols: antioxidants and beyond. Am J Clin Nutr. 2005;81(1 Suppl):215S-217S. doi:10.1093/ajcn/81.1.215S
32. Bielli A, Scioli MG, Mazzaglia D, Doldo E, Orlandi A. Antioxidants and vascular health. Life Sci. 2015;143:209-216. doi:10.1016/j.lfs.2015.11.012
33. Tabernero M, Serrano J, Saura-Calixto F. The antioxidant capacity of cocoa products: contribution to the Spanish diet. Int J Food Sci Technol. 2006;41(s1):28-32. doi:10.1111/j.1365-2621.2006.01239.x
34. Serafini M, Testa MF, Villaño D, et al. Antioxidant activity of blueberry fruit is impaired by association with milk. Free Radic Biol Med. 2009;46(6):769-774. doi:10.1016/j.freeradbiomed.2008.11.023
35. Bourassa P, Côté R, Hutchandani S, Samson G, Tajmir-Riahi H-A. The effect of milk alpha-casein on the antioxidant activity of tea polyphenols. J Photochem Photobiol B. 2013;128:43-49. doi:10.1016/j.jphotobiol.2013.07.021

## Hazards of Long-Term Cow's Milk Consumption

### Chronic Consumption Leads to Chronic Disease (25)

1. Saxton RA, Sabatini DM. mTOR signaling in growth, metabolism, and disease. Cell. 2017;168(6):960-976. doi:10.1016/j.cell.2017.02.004
2. Melnik BC. Milk—a nutrient system of mammalian evolution promoting mTORC1-dependent translation. Int J Mol Sci. 2015;16(8):17048-17087. doi:10.3390/ijms160817048
3. Han YY, Forno E, Brehm JM, et al. Diet, interleukin 17, and childhood asthma in Puerto Ricans. Ann Allergy Asthma Immunol. 2015;115(4):288-293.e1. doi:10.1016/j.anai.2015.07.020
4. Frosh A, Cruz C, Wellsted D, Stephens J. Effect of a dairy diet on nasopharyngeal mucus secretion. The Laryngoscope. 2019;129(1):13-17. doi:10.1002/lary.27287
5. Bartley J, McGlashan SR. Does milk increase mucus production? Med Hypotheses. 2010;74(4):732-734. doi:10.1016/j.mehy.2009.10.044
6. Han YY, Forno E, Alvarez M, et al. Diet, lung function, and asthma exacerbations in Puerto Rican children. Pediatr Allergy Immunol Pulmonol. 2017;30(4):202-209. doi:10.1089/ped.2017.0803
7. Yusoff NA, Hampton SM, Dickerson JW, Morgan JB. The effects of exclusion of dietary egg and milk in the management of asthmatic children: a pilot study. J R Soc Promot Health. 2004;124(2):74-80. doi:10.1177/146642400412400211
8. Egger J, Carter CM, Wilson J, Turner MW, Soothill JF. Is migraine food allergy? A double-blind controlled trial of oligoantigenic diet treatment. Lancet. 1983;2(8355):865-869. doi:10.1016/s0140-6736(83)90866-8
9. Karjalainen J, Martin JM, Knip M, et al. A bovine albumin peptide as a possible trigger of insulin-dependent diabetes mellitus [published correction appears in N Engl J Med 1992 Oct 22;327(17):1252]. N Engl J Med. 1992;327(5):302-307. doi:10.1056/NEJM199207303270502
10. Infant feeding practices and their possible relationship to the etiology of diabetes mellitus. American Academy of Pediatrics Work Group on Cow's Milk Protein and Diabetes Mellitus. Pediatrics. 1994;94(5):752-754.
11. Vaarala O, Paronen J, Otonkoski T, Akerblom HK. Cow milk feeding induces antibodies to insulin in children--a link between cow milk and insulin-dependent diabetes mellitus? Scand J Immunol. 1998;47(2):131-135. doi:10.1046/j.1365-3083.1998.00282.x
12. Goldfarb MF. Relation of time of introduction of cow milk protein to an infant and risk of type-1 diabetes mellitus. J Proteome Res. 2008;7(5):2165-2167. doi:10.1021/pr800041d
13. Clemens RA. Milk A1 and A2 peptides and diabetes. Nestle Nutr Workshop Ser Pediatr Program. 2011;67:187-195. doi:10.1159/000325584
14. Clatici VG, Voicu C, Voaides C, Roseanu A, Icriverzi M, Jurcoane S. Diseases of civilization - cancer, diabetes, obesity and acne - the implication of milk, IGF-1 and mTORC1. Maedica. 2018;13(4):273-281. doi:10.26574/maedica.2018.13.4.273
15. Melnik BC, John SM, Schmitz G. Over-stimulation of insulin/IGF-1 signaling by western diet may promote diseases of civilization: lessons learnt from laron syndrome. Nutr Metab. 2011;8:41. doi:10.1186/1743-7075-8-41
16. Samuel VT, Shulman GI. Integrating mechanisms for insulin resistance: common threads and missing links. Cell. 2012;148(5):852-871. doi:10.1016/j.cell.2012.02.017
17. Prentice AM. Macronutrients as sources of food energy. Public Health Nutr. 2005;8(7A):932-939. doi:10.1079/phn2005779
18. Guo Z. Intramyocellular lipid kinetics and insulin resistance. Lipids Health Dis. 2007;6(1). doi:10.1186/1476-511x-6-18.
19. Aucott L. Influences of weight loss on long-term diabetes outcomes: symposium on 'diet and diabetes'. Proc Nutr Soc, 2008;67(1), 54-59. doi:10.1017/S0029665108006022
20. Dahl-Jorgensen K, Joner G, Hanssen KF. Relationship between cow's milk consumption and incidence of IDDM in childhood. Diabetes Care. 1991;14(11):1081-1083. doi:10.2337/diacare.14.11.1081
21. Trapp CB, Barnard ND. Usefulness of vegetarian and vegan diets for treating type 2 diabetes. Curr Diab Rep. 2010;10(2):152-158. doi:10.1007/s11892-010-0093-7
22. Maruyama K, Oshima T, Ohyama K. Exposure to exogenous estrogen through intake of commercial milk produced from pregnant cows. Pediatr Int. 2010;52(1):33-38. doi:10.1111/j.1442-200X.2009.02890.x
23. Watanuki S, Takeshima S-N, Borjigin L, et al. Visualizing bovine leukemia virus (BLV)-infected cells and measuring BLV proviral loads in the milk of BLV seropositive dams. Vet Res. 2019;50(1):102. doi:10.1186/s13567-019-0724-1
24. *Dairy 2014: Milk Quality, Milking Procedures, and Mastitis on U.S. Dairies, 2014.* Fort Collins, CO: U.S. Department of Agriculture, National Agricultural Statistics Service and Animal and Plant Health Inspection Service; 2016. Report 2.
25. Kim H, Moon SY, Sohn MY, Lee WJ. Insulin-like growth factor-1 increases the expression of inflammatory biomarkers and sebum production in cultured sebocytes. Ann Dermatol. 2017;29(1):20-25. doi:10.5021/ad.2017.29.1.20
26. Hoppe C, Mølgaard C, Dalum C, Vaag A, Michaelsen KF. Differential effects of casein versus whey on fasting plasma levels of insulin, IGF-1 and IGF-1/IGFBP-3: results from a randomized 7-day supplementation study in prepubertal boys. Eur J Clin Nutr. 2009;63(9):1076-1083. doi:10.1038/ejcn.2009.34
27. Melnik BC. Acne vulgaris: The metabolic syndrome of the pilosebaceous follicle. Clin Dermatol. 2018;36(1):29-40. doi:10.1016/j.clindermatol.2017.09.006

28. Juhl CR, Bergholdt HKM, Miller IM, Jemec GBE, Kanters JK, Ellervik C. Dairy intake and acne vulgaris: a systematic review and meta-analysis of 78,529 children, adolescents, and young adults. Nutrients. 2018;10(8). doi:10.3390/nu10081049
29. Sarni AR, Baroni L. Milk and Parkinson disease: Could galactose be the missing link. Mediterr J Nutr Metab. 2019;12(1):91-118. doi:10.3233/MNM-180234
30. Hughes KC, Gao X, Kim IY, et al. Intake of dairy foods and risk of Parkinson disease. Neurology. 2017;89(1):46-52. doi:10.1212/WNL.0000000000004057


## Associations Between Dairy and Breast Cancer (28)


1. Breast Cancer. World Health Organization. http://www.who.int/cancer/prevention/diagnosis-screening/breast-cancer/en. Accessed April 21, 2020.
2. Male breast cancer - Symptoms and causes. Mayo Clinic. https://www.mayoclinic.org/diseases-conditions/male-breast-cancer/symptoms-causes/syc-20374740. Published February 28, 2020. Accessed April 21, 2020.
3. U.S. Breast Cancer Statistics. Breastcancer.org. https://www.breastcancer.org/symptoms/understand_bc/statistics. Published January 27, 2020. Accessed February 8, 2020.
4. Dinu M, Abbate R, Gensini GF, Casini A, Sofi F. Vegetarian, vegan diets and multiple health outcomes: A systematic review with meta-analysis of observational studies. Crit Rev Food Sci Nutr. 2017;57(17):3640-3649. doi:10.1080/10408398.2016.1138447
5. Fiolet T, Srour B, Sellem L, et al. Consumption of ultra-processed foods and cancer risk: results from NutriNet-Sante prospective cohort. BMJ. 2018;360. doi:10.1136/bmj.k322
6. Grant WB. A multicountry ecological study of cancer incidence rates in 2008 with respect to various risk-modifying factors. Nutrients. 2014 Jan; 6(1): 163–189. doi:10.3390/nu6010163
7. FoodData Central. Milk, Whole, 3.25% Milkfat, with Added Vitamin D. US Department of Agriculture, Agricultural Research Service. https://fdc.nal.usda.gov/fdc-app.html#/food-details/746782/nutrients. Published December 16, 2019. Accessed February 11, 2020.
8. Maruyama K, Oshima T, Ohyama K. Exposure to exogenous estrogen through intake of commercial milk produced from pregnant cows. Pediatr Int. 2010;52(1):33-38. doi:10.1111/j.1442-200X.2009.02890.x
9. Bitas D, Samanidou V. Molecularly imprinted polymers as extracting media for the chromatographic determination of antibiotics in milk. Mol Basel Switz. 2018;23(2). doi:10.3390/molecules23020316
10. Park SW, Kim JY, Kim YS, Lee SJ, Lee SD, Chung MK. A milk protein, casein, as a proliferation promoting factor in prostate cancer cells. World J Men's Health. 2014;32(2):76-82. doi:10.5534/wjmh.2014.32.2.76
11. Nielsen TS, Hojer A, Gustavsson A-M, Hansen-Moller J, Purup S. Proliferative effect of whey from cow's milk varying in phyto-oestrogens in human breast and prostate cancer cells. J Dairy Res. 2012;79(2):143-149. doi:10.1017/S0022029911000902
12. Kasozi KI, Natabo PC, Namubiru S, Tayebwa DS, Tamale A, Bamaiyi PH. Food safety analysis of milk and beef in southwestern Uganda. J Environ Public Health. 2018;2018:1627180. doi:10.1155/2018/1627180
13. Zhou X, Qu X, Zheng N, Su C, Wang J, Soyeurt H. Large scale study of the within and between spatial variability of lead, arsenic, and cadmium contamination of cow milk in China. Sci Total Environ. 2019;650(Pt 2):3054-3061. doi:10.1016/j.scitotenv.2018.09.094
14. McCann SE, Hays J, Baumgart CW, Weiss EH, Yao S, Ambrosone CB. Usual consumption of specific dairy foods is associated with breast cancer in the Roswell Park Cancer Institute data bank and biorepository. Curr Dev Nutr. 2017;1(3). doi:10.3945/cdn.117.000422
15. Kroenke CH, Kwan ML, Sweeney C, Castillo A, Caan BJ. High- and low-fat dairy intake, recurrence, and mortality after breast cancer diagnosis. J Natl Cancer Inst. 2013;105(9):616-623. doi:10.1093/jnci/djt027
16. Kaaks R, Johnson T, Tikk K, et al. Insulin-like growth factor I and risk of breast cancer by age and hormone receptor status-A prospective study within the EPIC cohort. Int J Cancer. 2014;134(11):2683-2690. doi:10.1002/ijc.28589
17. Renehan AG, Zwahlen M, Minder C, O'Dwyer ST, Shalet SM, Egger M. Insulin-like growth factor (IGF)-I, IGF binding protein-3, and cancer risk: systematic review and meta-regression analysis. Lancet Lond Engl. 2004;363(9418):1346-1353. doi:10.1016/S0140-6736(04)16044-3
18. Shi R, Yu H, McLarty J, Glass J. IGF-I and breast cancer: a meta-analysis. Int J Cancer. 2004;111(3):418-423. doi:10.1002/ijc.20233
19. Weroha SJ, Haluska P. The insulin-like growth factor system in cancer. Endocrinol Metab Clin North Am. 2012;41(2):335-350, vi. doi:10.1016/j.ecl.2012.04.014
20. Wang H, Goh VHH, Seow A, Lee HP, Yu MC. Determinants of circulating insulin-like growth factor I and insulin-like growth factor binding protein 3 concentrations in a cohort of Singapore men and women. Cancer Epidemiol Biomarkers Prev. 2003;12(8):739-746.
21. Heaney RP, McCarron DA, Dawson-Hughes B, et al. Dietary changes favorably affect bone remodeling in older adults. J Am Diet Assoc. 1999;99(10):1228-1233. doi:10.1016/S0002-8223(99)00302-8
22. Boyd NF, Stone J, Vogt KN, Connelly BS, Martin LJ, Minkin S. Dietary fat and breast cancer risk revisited: a meta-analysis of the published literature. Br J Cancer. 2003;89(9):1672-1685. doi:10.1038/sj.bjc.6601314
23. Thiebaut ACM, Kipnis V, Chang SC, et al. Dietary fat and postmenopausal invasive breast cancer in the National Institutes of Health-AARP Diet and Health Study cohort. J Natl Cancer Inst. 2007;99(6):451-462. doi:10.1093/jnci/djk094
24. Smith-Warner SA, Spiegelman D, Adami HO, et al. Types of dietary fat and breast cancer: a pooled analysis of cohort studies. Int J Cancer. 2001;92(5):767-774. doi:10.1002/1097-0215(20010601)92:5<767::aid-ijc1247>3.0.co;2-0
25. Anjom-Shoae J. Dietary intake and serum levels of trans fatty acids and risk of breast cancer: A systematic review and dose-response meta-analysis of prospective studies. Clin Nutr. 2020;39(3):755-764. doi:10.1016/j.clnu.2019.03.024
26. Qin LQ, Xu JY, Wang PY, Tong J, Hoshi K. Milk consumption is a risk factor for prostate cancer in Western countries: evidence from cohort studies. Asia Pac J Clin Nutr. 2007;16(3):467-476.
27. Walter C. Willett, Ludwig DS. Milk and Health. N Engl J Med. 2020;382(7):644-654. doi: 10.1056/NEJMra1903547
28. Stang A, Ahrens W, Baumgardt-Elms C, et al. Adolescent milk fat and galactose consumption and testicular germ cell cancer. Cancer Epidemiol Biomarkers Prev. 2006;15(11):2189-2195. doi:10.1158/1055-9965.EPI-06-0372
29. Qin B, Moorman PG, Alberg AJ, et al. Dairy, calcium, vitamin D and ovarian cancer risk in African-American women. Br J Cancer. 2016;115(9):1122-1130. doi:10.1038/bjc.2016.289
30. Kaiser Permanente. High-fat dairy products linked to poorer breast cancer survival. Science Daily. https://www.sciencedaily.com/releases/2013/03/130314180136.htm. Published March 14, 2013. Accessed June 18, 2020.
31. Pape-Zambito DA, Roberts RF, Kensinger RS. Estrone and 17beta-estradiol concentrations in pasteurized-homogenized milk and commercial dairy products. J Dairy Sci. 2010;93(6):2533-2540. doi:10.3168/jds.2009-2947
32. Henderson BE, Ross RK, Pike MC, Casagrande JT. Endogenous hormones as a major factor in human cancer. Cancer Res. 1982;42(8):3232-3239.
33. Chen WY. Exogenous and endogenous hormones and breast cancer. Best Pract Res Clin Endocrinol Metab. 2008;22(4):573-585. doi:10.1016/j.beem.2008.08.001
34. Di Sante G, Di Rocco A, Pupo C, Casimiro MC, Pestell RG. Hormone-induced DNA damage response and repair mediated by cyclin D1 in breast and prostate cancer. Oncotarget. 2017;8(47):81803-81812. doi:10.18632/oncotarget.19413
35. Badowska-Kozakiewicz AM, Patera J, Sobol M, Przybylski J. The role of oestrogen and progesterone receptors in breast cancer – immunohistochemical evaluation of oestrogen and progesterone receptor expression in invasive breast cancer in women. Contemp Oncol. 2015;19(3):220-225. doi:10.5114/wo.2015.51826
36. Haimov-Kochman R, Shore LS, Laufer N. The milk we drink, food for thought. Fertil Steril. 2016;106(6):1310-1311. doi:10.1016/j.fertnstert.2016.09.031


## Toxins and Environmental Impact of Dairy (30)


1. Sachdev HP, Krishna J, Puri RK, Satyanarayana L, Kumar S. Water supplementation in exclusively breastfed infants during summer in the tropics. Lancet. 1991;337(8747):929-933. doi:10.1016/0140-6736(91)91568-f
2. Plant J. A comparison between human milk and cow's milk. Viva! - The Vegan Charity. https://www.viva.org.uk/white-lies/comparison-between-human-milk-and-cows-milk. Published February 2014. Accessed February 9, 2020.
3. Chen X, Lin Y, Dang K, Puschner B. Quantification of polychlorinated biphenyls and polybrominated diphenyl ethers in commercial cow's milk from California by gas chromatography-triple quadruple mass spectrometry. PloS One. 2017;12(1):e0170129. doi:10.1371/journal.pone.0170129
4. Gore AC, Chappell VA, Fenton SE, et al. Executive summary to EDC-2: The endocrine society's second scientific statement on endocrine-disrupting chemicals. Endocr Rev. 2015;36(6):593-602. doi:10.1210/er.2015-1093
5. Koyuncu M, Alwazeer D. Determination of trace elements, heavy metals, and antimony in polyethylene terephthalate-bottled local raw cow milk of Iğdır region in Turkey. Environ Monit Assess. 2019;191(11):666. doi:10.1007/s10661-019-7851-z
6. Sethi S, Chen X, Kass PH, Puschner B. Polychlorinated biphenyl and polybrominated diphenyl ether profiles in serum from cattle, sheep, and goats across California. Chemosphere. 2017;181:63-73. doi:10.1016/j.chemosphere.2017.04.059
7. Weber R, Herold C, Hollert H, Kamphues J, Blepp M, Ballschmiter K. Reviewing the relevance of dioxin and PCB sources for food from animal origin and the need for their inventory, control and management. Environ Sci Eur. 2018;30(1):42. doi:10.1186/s12302-018-0166-9

8. Zwierzchowski G, Ametaj BN. Minerals and heavy metals in the whole raw milk of dairy cows from different management systems and countries of origin: a meta-analytical study. J Agric Food Chem. 2018;66(26):6877-6888. doi:10.1021/acs.jafc.8b00904
9. Zacharia JT. Degradation Pathways of Persistent Organic Pollutants (POPs) in the Environment. In Donyinah SK, ed. *Persistent Organic Pollutants*. London, United Kingdom: IntechOpen; 2019. doi:10.5772/intechopen.79645
10. Dioxins and Their Effects on Human Health. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/dioxins-and-their-effects-on-human-health. Published October 4, 2016. Accessed February 9, 2020.
11. Kretzer, M. Filthy N.C. Dairy Farm Shuts Down Following PETA Investigation. PETA. https://investigations.peta.org/north-carolina-dairy-farm/farm-shuts-down. Accessed April 27, 2020.
12. Video Reveals That Neglected, Lame Cows Suffer in Pain and Filth at Pennsylvania Dairy—Just for Cheese. PETA. https://investigations.peta.org/reitz-dairy-farm-neglect. Published June 28, 2019. Accessed April 27, 2020.
13. Sonnier JL, Karns JS, Lombard JE, et al. Prevalence of Salmonella enterica, Listeria monocytogenes, and pathogenic Escherichia coli in bulk tank milk and milk filters from US dairy operations in the National Animal Health Monitoring System Dairy 2014 study. J Dairy Sci. 2018;101(3):1943-1956. doi:10.3168/jds.2017-13546
14. Oliver SP, Jayarao BM, Almeida RA. Foodborne pathogens in milk and the dairy farm environment: food safety and public health implications. Foodborne Pathog Dis. 2005;2(2):115-129. doi:10.1089/fpd.2005.2.115
15. Sawant AA, Sordillo LM, Jayarao BM. A survey on antibiotic usage in dairy herds in Pennsylvania. J Dairy Sci. 2005;88(8):2991-2999. doi:10.3168/jds.S0022-0302(05)72979-9
16. Feng X, Chambers LR, Knowlton KF. Antibiotic resistance genes in the faeces of dairy cows following short-term therapeutic and prophylactic antibiotic administration. J Appl Anim Res. 2020;48(1):34-37. doi:10.1080/09712119.2019.1698428
17. Rychen G, Jurjanz S, Toussaint H, Feidt C. Dairy ruminant exposure to persistent organic pollutants and excretion to milk. Anim Int J Anim Biosci. 2008;2(2):312-323. doi:10.1017/S1751731107001139
18. Sachi S, Ferdous J, Sikder MH, Azizul Karim Hussani SM. Antibiotic residues in milk: Past, present, and future. J Adv Vet Anim Res. 2019;6(3):315-332. doi:10.5455/ javar.2019.f350
19. Sapkota AR, Lefferts LY, McKenzie S, Walker P. What do we feed to food-production animals? A review of animal feed ingredients and their potential impacts on human health. Environ Health Perspect. 2007;115(5):663-670. doi:10.1289/ehp.9760
20. Maruyama K, Oshima T, Ohyama K. Exposure to exogenous estrogen through intake of commercial milk produced from pregnant cows. Pediatr Int. 2010;52(1):33-38. doi:10.1111/j.1442-200X.2009.02890.x
21. Chege P. Analysis of Contamination Points of Milk through the Whole Value Chain Process and the Quality of Milk Products in the Dairy Industry. Avid Science. https://www.avidscience.com/wp-content/uploads/2016/06/FQC-16-01_June-11-2016.pdf. Published June 2016. Accessed April 27, 2020.
22. Golden Valley Agricultural Research Trust. Manual on Milk Safety, Quality and Hygiene. Makerere University E-Learning Environment. https://muele.mak.ac.ug/pluginfile.php/246514/mod_resource/content/3/Dairy%20manual%20-%20Milk%20quality.pdf. Published May 2011. Accessed April 27, 2020.
23. Center for Food Safety and Applied Nutrition. *Guidance for Industry: Sanitary Transportation of Food*. Washington, DC: U.S. Food and Drug Administration. https://www.fda.gov/regulatory-information/search-fda-guidance-documents/guidance-industry-sanitary-transportation-food. Updated September 20, 2018. Accessed April 27, 2020.
24. Groner A, Broumis C, Fang R, et al. Effective inactivation of a wide range of viruses by pasteurization. Transfusion. 2018;58(1):41-51. doi:10.1111/trf.14390
25. Awasthi V, Bahman S, Thakur LK, Singh SK, Dua A, Ganguly S. Contaminants in milk and impact of heating: an assessment study. Indian J Public Health. 2012;56(1):95-99. doi:10.4103/0019-557X.96985
26. Ismail A, Akhtar S, Levin RE, Ismail T, Riaz M, Amir M. Aflatoxin M1: Prevalence and decontamination strategies in milk and milk products. Crit Rev Microbiol. 2016;42(3):418-427. doi:10.3109/1040841X.2014.958051
27. Dairy | Industries. World Wildlife Fund. https://www.worldwildlife.org/industries/dairy. Accessed February 9, 2020.
28. US Factory Farming Estimates. Sentience Institute. http://www.sentienceinstitute.org/us-factory-farming-estimates. Updated April 11, 2019. Accessed April 28, 2020.
29. Burkholder J, Libra B, Weyer P, et al. Impacts of waste from concentrated animal feeding operations on water quality. Environ Health Perspect. 2007;115(2):308-312. doi:10.1289/ehp.8839
30. Beef | Industries. World Wildlife Fund. https://www.worldwildlife.org/industries/beef. Accessed April 28, 2020.
31. Sizemore GC. Accounting for biodiversity in the dairy industry. J Environ Manage. 2015;155:145-153. doi:10.1016/j.jenvman.2015.03.015

## Racial Differences in Lactose Digestion and Disease Rates (32)

1. Labrie V, Buske OJ, Oh E, et al. Lactase nonpersistence is directed by DNA-variation-dependent epigenetic aging. Nat Struct Mol Biol. 2016;23(6):566-573. doi:10.1038/nsmb.3227
2. Lactose Intolerance page: National Library of Medicine. Genetics Home Reference. https://ghr.nlm.nih.gov/condition/lactose-intolerance. Reviewed May 2010. Accessed November 15, 2019.
3. Itan Y, Powell A, Beaumont MA, Burger J, Thomas MG. The origins of lactase persistence in europe. PLoS Comput Biol. 2009;5(8). doi:10.1371/journal.pcbi.1000491
4. Bloom G, Sherman PW. Dairying barriers affect the distribution of lactose malabsorption. Evol Hum Behav. 2005;26(4):301-312. doi:10.1016/j.evolhumbehav.2004.10.002
5. Swagerty DL Jr, Walling AD, Klein RM. Lactose intolerance [published correction appears in Am Fam Physician. 2003 Mar 15;67(6):1195]. Am Fam Physician. 2002;65(9):1845-1850.
6. *Lactose Intolerance: Information for Health Care Providers.* Rockville, MD: National Institute of Child Health and Human Development; 2006. NIH Publication No. 05-5305B.
7. Rao DR, Bello H, Warren AP, Brown GE. Prevalence of lactose maldigestion. Influence and interaction of age, race, and sex. Dig Dis Sci. 1994;39(7):1519-1524. doi:10.1007/bf02088058
8. Solomons NW. Fermentation, fermented foods and lactose intolerance. Eur J Clin Nutr. 2002;56 Suppl 4:S50-55. doi:10.1038/sj.ejcn.1601663
9. *2015 – 2020 Dietary Guidelines for Americans. 8th Edition*. Washington, DC: U.S. Department of Health and Human Services and U.S. Department of Agriculture; 2015.
10. Bischoff-Ferrari HA, Dawson-Hughes B, Baron JA, et al. Milk intake and risk of hip fracture in men and women: a meta-analysis of prospective cohort studies. J Bone Miner Res. 2011;26(4):833-839. doi:10.1002/jbmr.279
11. Feskanich D, Bischoff-Ferrari HA, Frazier AL, Willett WC. Milk consumption during teenage years and risk of hip fractures in older adults. JAMA Pediatr. 2014;168(1):54-60. doi:10.1001/jamapediatrics.2013.3821
12. Michaelsson K, Wolk A, Langenskiold S, et al. Milk intake and risk of mortality and fractures in women and men: cohort studies. BMJ. 2014;349:g6015. doi:10.1136/bmj.g6015
13. Sonneville KR, Gordon CM, Kocher MS, Pierce LM, Ramappa A, Field AE. Vitamin d, calcium, and dairy intakes and stress fractures among female adolescents. Arch Pediatr Adolesc Med. 2012;166(7):595-600. doi:10.1001/archpediatrics.2012
14. Cauley JA. Defining ethnic and racial differences in osteoporosis and fragility fractures. Clin Orthop. 2011;469(7):1891-1899. doi:10.1007/s11999-011-1863-5
15. Barrett-Connor E, Siris ES, Wehren LE, et al. Osteoporosis and fracture risk in women of different ethnic groups. J Bone Miner Res. 2005;20(2):185-194. doi:10.1359/JBMR.041007
16. Zengin A, Prentice A, Ward KA. Ethnic differences in bone health. Front endocrinol. 2015;6. doi:10.3389/fendo.2015.00024
17. Aloia JF. African Americans, 25-hydroxyvitamin D, and osteoporosis: a paradox. Am J Clin Nutr. 2008;88(2):545S-550S. doi:10.1093/ajcn/88.2.545S
18. Cauley JA, Lui LY, Stone KL, et al. Longitudinal study of changes in hip bone mineral density in Caucasian and African-American women. J Am Geriatr Soc. 2005;53(2):183-189. doi:10.1111/j.1532-5415.2005.53101.x
19. Aloia JF, Shieh A, Mikhail M, Islam S. Urinary calcium excretion in postmenopausal African American women. Clin Nephrol. 2015;84(3):130-137. doi:10.5414/CN108548
20. Plawecki KL, Evans EM, Mojtahedi MC, McAuley E, Chapman-Novakofski K. Assessing calcium intake in postmenopausal women. Prev Chronic Dis. 2009;6(4):A124.
21. Weaver CM. Adolescence: the period of dramatic bone growth. Endocrine. 2002;17(1):43-48. doi:10.1385/ENDO:17:1:43
22. Saggese G, Baroncelli GI, Bertelloni S. Puberty and bone development. Best Pract Res Clin Endocrinol Metab. 2002;16(1):53-64. doi:10.1053/beem.2001.0180
23. Clemens RA. Milk A1 and A2 peptides and diabetes. Nestle Nutr Workshop Ser Pediatr Program. 2011;67:187-95. doi: 10.1159/000325584.
24. Han YY, Forno E, Brehm JM, et al. Diet, interleukin-17, and childhood asthma in Puerto Ricans. Ann Allergy Asthma Immunol. 2015;115(4):288-293.e1. doi:10.1016/j.anai.2015.07.020
25. Sarni AR, Baroni L. Milk and Parkinson disease: Could galactose be the missing link. Mediterr J Nutr Metab. 2019;12(1):91-118. doi:10.3233/MNM-180234
26. Qin LQ, Xu JY, Wang PY, Tong J, Hoshi K. Milk consumption is a risk factor for prostate cancer in Western countries: evidence from cohort studies. Asia Pac J Clin Nutr. 2007;16(3):467-476.
27. Stang A. Adolescent milk fat and galactose consumption and testicular germ cell cancer. Cancer Epidemiol Biomarkers Prev. 2006 Nov;15(11):2189-95. doi:10.1158/1055-9965.EPI-06-0372.

28. Qin B, Moorman PG, Alberg AJ, et al. Dairy, calcium, vitamin D and ovarian cancer risk in African-American women. Br J Cancer. 2016;115(9):1122-1130. doi:10.1038/bjc.2016.289
29. Walter C. Willett, Ludwig DS. Milk and Health. N Engl J Med. 2020;382(7):644-654. doi:10.1056/NEJMra1903547
30. Kroenke CH, Kwan ML, Sweeney C, Castillo A, Caan BJ. High- and low-fat dairy intake, recurrence, and mortality after breast cancer diagnosis. J Natl Cancer Inst. 2013;105(9):616-623. doi:10.1093/jnci/djt027
31. Cooper RS. Genetic Factors in Ethnic Disparities in Health. In Anderson NB, Bulatao RA, Cohen B, National Research Council (US) Panel on Race, Ethnicity, and Health in Late Life, eds. *Critical Perspectives on Racial and Ethnic Differences in Health in Late Life*. Washington, DC: National Academies Press; 2004;267-309. https://www.ncbi.nlm.nih.gov/books/NBK25517.
32. Baciu A, Negussie Y, Geller A, et al. *The State of Health Disparities in the United States in Communities in Action: Pathways to Health Equity.* The National Academies of Science, Engineering, & Medicine. Washington, DC: The National Academies Press; 2017.
33. Geiger HJ. Racial and Ethnic Disparities in Diagnosis and Treatment: A Review of the Evidence and a Consideration of Causes. In Institute of Medicine (US) Committee on Understanding and Eliminating Racial and Ethnic Disparities in Health Care, Smedley BD, Stith AY, Nelson AR, eds. *Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care*. Washington, DC: National Academy Press (US); 2003.
34. Delivering on the Dietary Guidelines: How Stronger Nutrition Policy Can Cut Healthcare Costs and Save Lives. Union of Concerned Scientists. https://www.ucsusa.org/resources/delivering-dietary-guidelines. Published June 3, 2019. Accessed April 24, 2020.
35. Newman C, Ralston K. *Profiles of Participants in the National School Lunch Program. Data From Two National Surveys*. Washington, DC: U.S. Department of Agriculture, Economic Research Service; 2006. Economic Information Bulletin Number 17.

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## Resources

### Dairy-Free Sample Meals

Finding dairy-free meals that fuel you isn't complicated—it's as simple as reaching into your fridge and combining a few nutritious staples. From nourishing dairy-free breakfasts to plant-based dinners you'll look forward to, these easy meals are perfect for those just getting started or those who want to cook more at home. Check out what a dairy-free day of eating looks like:
https://switch4good.org/learn/dairy-free-meal-plan/

### Dairy-Free Recipes

All the dairy-free recipes and dairy-free alternatives you could ever crave or need are right here:
https://switch4good.org/food/

### Lactose Intolerance Test

Are you wondering if you're lactose intolerant? Sixty-five percent of the global population is. If you experience bloating, gas, diarrhea, or other stomach issues, it could be the dairy in your diet (you'd be surprised to find out all the foods it's in, like crackers!). Take the test to find out. Get the results and information you need to feel better for *good*:
https://switch4good.org/lactose-intolerance-test/

### Dairy-Free Protein Sources

How to recover from workouts the dairy-free way: https://switch4good.org/plant-based-protein/

### How to Go Dairy-Free

"Lifestyle change" might seem like an intimidating term, and for some, removing dairy from their diet can feel like a monumental shift. Don't worry—it's not. Take a deep breath and focus on these 5 incremental steps you can take to make the change less daunting:
https://switch4good.org/make-the-switch/

### Two-Week Dairy-Free Challenge

We often don't connect our ailments with the food we eat, but dairy can be responsible for a number of uncomfortable and chronic symptoms many of us deal with every day. Constant cough, itchy skin, persistent acne, wheezing, annoying sniffles, and embarrassing bloat and gas are all side effects one may feel after consuming dairy. Imagine how you might feel if you gave up this symptom-inducing food. Wouldn't it be nice to live without these ailments?
Try the Dairy Detox:
https://switch4good.org/dairy-detox/

### Athlete Power Plate

Learn how to build a dairy-free power plate to get the most nutrition out of your meal.
Download this tool here:
https://switch4good.org/wp-content/uploads/2020/09/AthletePowerPlate.pdf

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