

Analysis of Health Problems Associated with High-Protein, High-Fat, Carbohydrate-Restricted Diets Reported via an Online Registry

Physicians Committee for Responsible Medicine
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Introduction

While a few recent studies have noted that high-protein, carbohydrate-restricted diets facilitate modest short-term weight loss,¹⁻³ no studies to date have investigated the long-term health consequences of consuming such diets for weight-loss purposes.

Diets high in fat, especially saturated fat, are associated with increased risk of cancer,⁴⁻⁶ diabetes,⁷ and heart disease.⁷ Diets high in animal protein have been shown to increase the risk of kidney problems,^{8,9} osteoporosis,^{10,11} and some types of cancer.^{12,13} Because fiber is found only in plant foods, and high-protein, high-fat, carbohydrate-restricted diets tend to be low in plant foods, these diets are also typically low in fiber. Low fiber intake is associated with increased risk of colon cancer and other malignancies,⁴ heart disease,⁷ diabetes,^{14,15} and constipation.¹⁶

Some high-protein, very-low-carbohydrate, weight-loss diets are designed to induce ketosis, a state that also occurs in uncontrolled diabetes mellitus and starvation. When carbohydrate intake or utilization is insufficient to provide glucose to the cells that rely on it as an energy source, ketone bodies are formed from fatty acids. An increase in circulating ketones can disturb the body's acid-base balance, causing metabolic acidosis. Even mild acidosis can have potentially deleterious consequences over the long run, including hypophosphatemia (low blood phosphate levels), resorption of calcium from bone, increased risk of osteoporosis, and an increased propensity to form kidney stones.¹⁷

For these reasons, high-protein, high-fat, low-fiber, carbohydrate-restricted diets, such as the Atkins Diet, especially when used for prolonged periods, are expected to increase the risk of multiple chronic diseases and other health problems, despite the weight loss that may accompany their use. Herein, we summarize the reports of individuals who have experienced health problems while on a high-protein, high-fat, carbohydrate-restricted diet who have offered their information through an online registry (www.atkinsdietalert.org/registry.html). The seriousness of the reported health problems highlights the importance of tracking the impact of the use of these potentially risky diets and the need for research into the long-term health consequences of using these diets for weight loss and maintenance.

Methods

In the fall of 2002, the Physicians Committee for Responsible Medicine began a pilot program testing the feasibility of an online registry for identifying people who may have suffered health complications related to high-protein, low-carbohydrate diets. A modest Internet advertising campaign was used to notify consumers about the availability of this registry.

To report problems with high-protein, high-fat, carbohydrate-restricted diets, individuals voluntarily visited www.atkinsdietalert.org and filled out a form available on the site. The registry specifically inquires about the following problems: heart attack, other heart problems, high cholesterol, diabetes, gout, gallbladder, colorectal cancer, other cancers, osteoporosis, reduced kidney function, kidney stones, constipation, difficulty concentrating, bad breath, and loss of energy. In addition, many registrants related other problems they had experienced while on Atkins-like diets in an “other problems” box offered on the registry. Many registrants reported more than one health concern. Through this online form, most registrants also provided contact information, age, sex, previous health concerns, length of time on the diet, reasons for choosing the diet, and other information.

To help clarify the possible biological mechanisms by which a high-protein, high-fat, carbohydrate-restricted diet might lead to these problems, PCRM dietitians conducted nutrient analysis of the sample menus for the three stages of the Atkins Diet as described in *Dr. Atkins' New Diet Revolution* (Avon; 2001; pp. 257–259), using Nutritionist V, Version 2.0, for Windows 98 (First DataBank Inc., Hearst Corporation, San Bruno, Calif.).

Findings

Up until November of 2003, 188 individuals reported experiencing problems with high-protein, high-fat, carbohydrate-restricted diets via the online registry. Table 1 lists the common health concerns identified in the online form. Table 2 summarizes health problems noted by three or more individuals in the write-in section of the form.

Table 1. Common Problems Reported by Atkins Diet Alert Registrants

44% reported constipation
42% reported loss of energy
40% reported bad breath
31% reported difficulty concentrating
22% reported kidney problems: kidney stones (11%), severe kidney infections (2%), or reduced kidney function (9%)
20% reported heart-related problems, including heart attack (1%), other heart problems (12%), or high cholesterol (7%)
11% reported gallbladder problems or removal
5% reported gout
5% reported diabetes
5% reported osteoporosis
4% reported colorectal (1%) or other cancers (3%)

Table 2. Other Problems Reported by Three or More Individuals:

11 reported irritable bowel syndrome, severe abdominal pain, or cramps (6%)
9 reported pain, cramps, tingling, or numbness in the limbs (5%)
9 reported feeling shaky and weak (5%)
9 reported vertigo, dizziness, or lightheadedness (5%)
7 reported severe diarrhea (4%)
7 reported severe or repeated headaches (4%)
5 reported severe mood swings, apathy, or depression (3%)
5 reported general malaise (3%)
4 reported nausea (2%)
4 reported severe menstrual problems (2%)
3 reported heart palpitations (2%)

As an example of a high-protein, carbohydrate-restricted diet, Table 3 presents a nutrient analysis of the sample menus for the three stages of the Atkins Diet as described in *Dr. Atkins' New Diet Revolution* (pp. 257–259). Actual menus analyzed can be found in Appendix A of this report.

Table 3. Nutrient Analysis of Atkins Sample Diets

	Atkins Induction	Atkins Weight Loss	Atkins Maintenance
Energy, kcal	1759	1505	2173
Protein, g (% energy)	143 (33%)	120 (32%)	135 (25%)
Carbohydrate, g (% energy)	15 (3%)	36 (10%)	116 (22%)
Fat, g (% energy)	125 (64%)	97 (58%)	110 (45%)
Alcohol, g (% energy)	0	0	26 (8%)
Saturated fat, g	42	45	38
Cholesterol, mg	886	885	834
Fiber, g	2	7	18
Calcium, mg (% DV)	373 (37%)	952 (95%)	1019 (102%)
Iron, mg (% DV)	15 (86%)	10 (54%)	13 (70%)
Vitamin C (% DV)	20 (33%)	140 (234%)	242 (404%)
Vitamin A, RE (% DV)	799 (80%)	1525 (153%)	2521 (252%)
Folate, μ g (% DV)	143 (36%)	268 (67%)	584 (146%)
Vitamin B-12, 5g (% DV)	11 (191%)	8 (132%)	5 (80%)
Thiamin, mg (% DV)	0.7 (48%)	1.1 (76%)	1.0 (64%)

The nutritional analysis shows that the sample menus do not meet recommended dietary intakes for macronutrients. In addition to very high protein content and low carbohydrate content, the menus at all three stages are very high in saturated fat (Daily Value is < 20 g) and cholesterol (DV < 200 mg) and very low in fiber (DV > 25 g). In addition, these sample menus do not reach daily values for iron. The Induction Menu does not meet the daily values for calcium, vitamin C, vitamin A, folate, and thiamin. The Weight Loss Menu is low on calcium, folate, and thiamin.

Discussion

Nutrient Composition

Our nutrient analysis agrees with other reports noting that high-protein diets typically skew nutritional intake toward higher-than-recommended amounts of dietary cholesterol, fat, saturated fat, and protein, and have very low levels of fiber and some other protective dietary constituents. The Nutrition Committee of the Council on Nutrition, Physical Activity, and Metabolism of the American Heart Association states, “High-protein diets are not recommended because they restrict healthful foods that provide essential nutrients and do not provide the variety of foods needed to adequately meet nutritional needs. Individuals who follow these diets are therefore at risk for compromised vitamin and mineral intake, as well as potential cardiac, renal, bone, and liver abnormalities overall.”¹⁸

Common Health Concerns

Constipation was reported by 44 percent of the registrants. One registrant reported severe problems with constipation: “I frequently resorted to laxatives and sometimes went two weeks without a bowel movement.” In one study, 68 percent of subjects on a low-carbohydrate diet reported problems with constipation.¹

Carbohydrate-rich plant foods, including vegetables, fruits, grains, and legumes, are the main sources of fiber in the diet. High-protein, carbohydrate-restricted diets are typically low in fiber, and, as a result, often lead to constipation. In our nutrient analysis of the sample menus in *Dr. Atkins’ New Diet Revolution*, fiber content ranged from two grams per day on the Induction Diet to 18 grams per day on the Maintenance Diet. The new Institute of Medicine recommendations target fiber intake at 14 grams per 1000 kcals, which works out to 28 to 42 grams per day for an average adult. Individuals consuming Atkins-like diets generally fall far short of this healthy goal.

Loss of energy was reported by 42 percent of registrants. One registrant noted feeling “exhausted, dizzy, and nauseated before almost passing out on the 5 day of the diet.” Another noted being “so weak I can hardly function.” A third stated, “After two weeks I felt terribly tired and ended the diet with a donut binge session.”

Loss of energy would be expected on a carbohydrate-restricted diet, because the preferred fuel for the body is carbohydrate in the circulating form of glucose or the storage form of glycogen. Muscles need glucose to do maximal effort work.¹⁹ Limiting carbohydrate intake requires the body to utilize other fuels, such as fats, amino acids, and ketone bodies. Conversion of these nutrients to useable fuels takes longer than providing glucose from carbohydrates. For brain function and high-intensity activities, these fuels are poor substitutes for glucose. In addition, during the induction and maintenance phases, recommended caloric intake (1500–1700 kcals) is well below adult energy requirements.

Bad breath was reported by 40 percent of the registrants. One registrant noted, “I was miserable on this diet. I had no appetite, no energy, and a terrible taste in my mouth all the time.” A second summed up her statement with, “Bad breath, funny taste in mouth, feeling lethargic...and this diet is good for you? My body didn't think so!”

Bad breath occurs on high-protein, carbohydrate-restricted diets, especially during the induction and weight-loss phases, when a ketotic state is achieved. Problems with bad breath were reported in 63 percent of patients on such diets in a study done at Duke University.¹ When fatty acids are the primary source of energy and carbohydrate is severely restricted, part of the fat particle cannot be metabolized and builds up in the fluids outside the cells. These particles are converted to ketones (an “emergency” energy source), and unused ketones are excreted in the urine and expired air, resulting in acetone-smelling breath.¹⁶

Difficulty concentrating was reported by 31 percent of the registrants. One registrant described her experience this way: “I felt horrible. I couldn't concentrate or focus and felt foggy all the time.” Another stated, “I was only on the diet a short time and had a vertigo attack. I have since been out of balance and have a loss of concentration.”

The primary fuel for the brain and nervous system is carbohydrate in the form of glucose. When carbohydrate or total food intake is restricted (especially when such restriction is <40 g/day), there is little or no glucose available for the brain. The brain cells can utilize ketone bodies for energy in an emergency, such as starvation or severe carbohydrate restriction,²⁰ but some individuals can still note the deficiency of glucose available to the brain. Possible symptoms include difficulty concentrating or light-headedness.

Kidney problems were reported by 22 percent of registrants: 11 percent reported kidney stones, 2 percent reported severe kidney infections, and 9 percent reported reduced kidney function. One registrant reported, “I have recurring kidney infections with elevated leukocytes and blood in my urine. I have tender flanks and am currently under a urologist's care to find the cause of the blood and the pain.” Another noted that he had three kidney stone episodes in the four months he was on a high-protein, carbohydrate-restricted diet. A person who experienced her first kidney stone episode while on a high-protein diet stated, “Even though I lost weight on the diet, if it's responsible for my experience with kidney stones, it's not worth it!”

High-protein diets are associated with reduced kidney function. Over time, individuals who consume very large amounts of animal protein risk permanent loss of kidney function. Harvard researchers reported recently that high-protein diets were associated with a significant decline in kidney function, based on observations in 1,624 women participating in the Nurses' Health Study. The damage was found only in those who already had reduced kidney function at the study's outset, but more than 40 percent of adults over age 40 in the United States already have reduced kidney function, which suggests that most people who have renal problems are unaware of that fact and do not realize that high-protein diets may put them at risk for further deterioration.^{9,21}

The American Academy of Family Physicians notes that high animal protein intake is largely responsible for the high prevalence of kidney stones in the United States and other developed countries and recommends protein restriction for the prevention of recurrent kidney stones.²² In part, this is because protein ingestion increases renal acid secretion and calcium resorption from bone and reduces renal calcium resorption. In addition, animal protein is a major dietary source of purines, the major precursors of uric acid, which is an important factor in some people who have a propensity to form kidney stones. When uric acid builds up, especially in an acid environment, it can precipitate in uric acid stone formers and decrease the solubility of calcium oxalate, a problem for calcium stone formers.^{17,22} This situation is aggravated when the diet is both high in protein and carbohydrate-restricted because ketone bodies compete with uric acid for renal tubular excretion such that uric acid levels can increase even further.²³

Cardiovascular disease, including heart attack, atrial fibrillation, coronary arteriosclerosis, and high blood cholesterol, was reported by 20 percent of the registrants. One registrant who had a heart scan that revealed no plaque or occlusions prior to starting a high-fat, high-protein, carbohydrate-restricted diet began experiencing angina after two years on the diet. An angiogram performed at that time showed a severe artery blockage; the registrant underwent angioplasty and stent placement. He said the diet “gave me heart disease.” Another described feeling as if “someone [was] boxing my ears with a very strong throbbing in my neck.” That registrant checked into the emergency room to learn that she had a heart rate of 210, which was slowed down with medication. She had developed atrial fibrillation, a condition in which disorganized electrical conduction in the atria (upper chambers of the heart) results in ineffective pumping of blood.

Typical high-protein diets are extremely high in dietary cholesterol and saturated fat. The effect of such diets on serum cholesterol concentrations is a matter of ongoing research. However, 7 percent of registrants reported high serum cholesterol concentrations. Other biochemical measures of heart disease risk may be affected. In a small study, individuals following high-protein diets against medical advice showed increases in fibrinogen, lipoprotein (a), and C-reactive protein, and demonstrable progression of coronary artery disease, suggesting that high-protein diets may precipitate progression of CAD through increases in lipid deposition and inflammatory and coagulation pathways.²⁴ Such diets pose additional cardiovascular risks, including increased risk for cardiovascular events immediately following a meal. Evidence indicates that meals high in saturated fat impair arterial compliance, increasing the risk of cardiovascular events in the postprandial period. A recent study showed that the consumption of a high-fat meal (a ham and cheese sandwich, whole milk, and ice cream) reduced systemic arterial compliance by 25 percent at three hours and 27 percent at six hours.²⁵

In a study comparing individuals on four different weight-loss diets (a moderate-fat diet without calorie restriction; a low-fat diet; a moderate-fat, calorie-controlled diet; and a high-fat diet), only patients following high-fat diets for weight loss showed a worsening of each cardiovascular disease risk factor (LDL-C, TG, TC, HDL-C, TC/HDL ratio, Ho, Lp(a), and fibrinogen), despite achieving statistically significant weight loss.²⁶

Researchers at the Framingham Heart Study have become concerned that users of high-protein, high-fat diets are at high risk of heart disease because frequent fatty meals increase levels of two of the most atherogenic (plaque-promoting) fatty particles in the blood stream: chylomicrons, which are the body's main fat-transporting particles; and free fatty acids, small fat particles that move freely in the blood stream. The research group has been studying the carotid arteries, a key artery in the neck that moves blood from the heart to the brain, of women in the Framingham Study for 12 years. The women who have chosen to consume a high-fat, carbohydrate-restricted diet have roughly double the deposits in their arteries as those on a higher-carbohydrate, lower-fat diet, clearly indicating an increased risk of stroke and heart disease (Wm. Castelli, personal communication, 2003).

A sudden cardiac death of an adolescent while using a high-protein, carbohydrate-restricted diet has been reported. The report's authors explain that, upon examination, the young woman was found to be severely hypokalemic (low in potassium). Severe blood mineral imbalances are possible on a high-protein, restricted-carbohydrate diet, especially when used in combination with low energy intake (as might occur during a weight-loss regimen). Potassium, calcium, and magnesium are all used by the body to neutralize acidity and balance blood pH levels. When ketone bodies are produced in a carbohydrate-restricted diet, metabolic acidosis results. The ketone bodies are paired with one of these minerals before being excreted in the urine. A prolonged ketotic state can thus result in depletion of blood minerals.²³ Mineral losses may also be compounded by the use of laxatives (to control problems with constipation associated with high-protein, low-carbohydrate diets) or diuretics. Low blood mineral levels can result in arrhythmias and even cardiorespiratory arrest.

Gallbladder problems were reported by 11 percent of registrants. In describing her experience with high-protein, low-carbohydrate diets, a young registrant stated, "All I ate was meat and lots of cheese...I ended up having to have my gallbladder removed." Her doctor told her that her gallbladder problems were caused by a fatty diet.

Risk of diseases of the gallbladder, including gallstones, gallbladder inflammation, and cholestasis (a sludge-like build up in the gallbladder), are increased with obesity, fasting, and rapid weight loss. A low-fat diet is usually the dietary treatment for acute gallbladder inflammation.¹⁶ The consumption of meaty diets has been shown to nearly double the risk of gallstones as compared to vegetarian diets in women.²⁷

Gout was reported by 5 percent of registrants. Gout is an excruciating type of arthritis characterized by joint swelling and pain caused by the accumulation of uric acid crystals in the joint fluid. Uric acid is produced when the body uses proteins. Ketosis associated with a high-protein, low-carbohydrate diet or fasting can precipitate an attack of gout.¹⁶

Osteoporosis was reported by 5 percent of the registrants. Elevated protein intake is known to encourage urinary calcium losses and has been shown to increase risk of fracture in cross-cultural and prospective studies.^{10,11} When carbohydrate is limited and a ketotic state is induced, this effect is magnified by the metabolic acidosis produced.¹⁷ In a 2002 study of 10 healthy individuals put on a low-carbohydrate, high-protein diet for six

weeks under controlled conditions, urinary calcium losses increased 55 percent (from 160 to 248 mg/d, $P < 0.01$).⁸ The researchers concluded that the diet presents a marked acid load to the kidney, increases the risk for kidney stones, and may increase the risk for bone loss.

Diabetes was reported by 5 percent of the registrants. One individual wrote that “her diabetes worsened,” but what stopped her from continuing was “the flank pain and almost tea-colored urine.”

In diabetes, renal impairment and cardiovascular disease are particularly common. The use of diets that may further tax the kidneys and may reduce arterial compliance is not recommended. Furthermore, contrary to some news reports, diets high in complex carbohydrates and low in fat do not impair glucose tolerance; most evidence indicates that such diets improve insulin sensitivity.

In individuals with diabetes, the principal strategies for preventing or slowing impairment of renal function include controlling blood glucose levels, blood pressure, and blood lipid concentrations, and decreasing protein intake to low normal levels. The beneficial effect of low-protein diets in diabetic nephropathy has been confirmed in two recent meta-analyses, with no adverse effects on the glycemic control.²⁸

Popular books and news stories have encouraged individuals to avoid carbohydrate-rich foods, suggesting that high-protein foods will not stimulate insulin release. However, contrary to this popular myth, proteins stimulate insulin release, just as carbohydrates do. Clinical studies indicate that beef and cheese cause a bigger insulin release than pasta, and fish produces a bigger insulin release than popcorn.²⁹

Cancer diagnoses were reported by 4 percent of registrants: 1 percent reported colorectal while 3 percent reported other cancers.

Colorectal cancer is one of the most common forms of cancer and is among the leading causes of cancer-related mortality. Long-term high intake of meat, particularly red meat, is associated with significantly increased risk of colorectal cancer. *Food, Nutrition, and the Prevention of Cancer*, a 1997 report by the World Cancer Research Fund and the American Institute for Cancer Research, reported that, based on available evidence, diets high in red meat were considered probable contributors to colorectal cancer risk.

Harvard studies including tens of thousands of women and men have shown that regular meat consumption increases colon cancer risk roughly 300 percent.^{12,13} Proposed mechanisms for the observed association include the effect of dietary fat on bile acid secretion, the action of cholesterol metabolites within the colonic lumen, and the carcinogenic action of heterocyclic amines produced during the cooking process, among others. In addition, high-protein diets are typically low in dietary fiber. Fiber facilitates the movement of wastes, including intraluminal carcinogens, out of the digestive tract and promotes a biochemical environment within the colon that appears to be protective against cancer.⁴

Similarly, the *Journal of the National Cancer Institute* recently reported that the rate of breast cancer among premenopausal women who ate the most animal (but not vegetable) fat was one third higher than that of women who ate the least animal fat.⁶ A separate study from Cambridge University, published in the *Lancet*, also linked diets high in saturated fat to breast cancer.⁵

Limitations on Weight Loss

Despite media accounts of seemingly dramatic weight loss, the effect of high-protein diets on body weight is similar to that of other weight-reduction diets. Three recent studies, one at Duke University,¹ a second at the University of Pennsylvania,² and a third at a Philadelphia medical center,³ suggest that mean weight loss with high-protein diets during the first six months of use is approximately 20 pounds. While this weight loss is greater than that which occurs from diets not designed for weight loss (e.g., diets based on the Food Guide Pyramid or National Cholesterol Education Program guidelines), it is not demonstrably greater than that which occurs with other weight-loss regimens or with low-fat, vegetarian diets prescribed without energy restrictions.³⁰

A closer look at the two studies published in the *New England Journal of Medicine* comparing low-carbohydrate diets and conventional (moderately low-fat [25–30%], restricted-calorie) diets for weight loss in obese adult subjects shows that weight loss over six to 12 months was minimal on both types of diets. Weight loss amounted to about half a pound per week at six months and one-fifth a pound per week at one year on the low-carbohydrate diet. Weight loss was about one-quarter to one-fifth a pound per week at six months and about one-tenth a pound per week at one year on the conventional weight-loss diet.^{2,3}

In one of these studies, the difference in weight loss between the groups was no longer apparent at one year.² The short-term difference in weight loss between the diets can be explained in both studies by lower caloric intake for those on the low-carbohydrate diet as compared to those on the conventional weight-loss diets. This is consistent with a recent review of 107 research studies on low-carbohydrate weight-loss diets, which concluded that weight loss was associated with longer diet duration and reduction of calories, but not with reduced carbohydrate intake.³¹

Limitations

The key limitation of this report is that adverse health effects were self-reported and are not likely to have the same prevalence in the general population. Data collection was Web-based and no attempt was made to assure a representative sample.

Urgent Need for Tracking Diet Risks

While these registry reports do not establish a cause-and-effect relationship between the use of high-protein, high-fat, carbohydrate-restricted diets and health problems, the serious nature of the reported problems points to the urgent need for monitoring the effects of such diets. We recommend that public health authorities begin tracking the use of high-protein, high-fat, carbohydrate-restricted diets used for weight loss or maintenance and record adverse events.

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Appendix

The nutrient analysis in Table 3: Nutrient Analysis of Atkins Sample Diets is based on the following sample menus, which are described in *Dr. Atkins' New Diet Revolution*.

Typical Induction Menu

Breakfast

Bacon, 4 slices
Coffee, decaf, 8 ounces
Scrambled eggs, 2

Lunch

Bacon cheeseburger, no bun:
 Bacon, 2 slices
 American cheese, 1 ounce
 Ground beef patty, 6 ounces
Small tossed salad, no dressing
Seltzer water

Dinner

Shrimp cocktail, 3 ounces
Mustard, 1 teaspoon
Mayonnaise, 1 tablespoon
Clear consommé, 1 cup
T-bone steak, 6 ounces
Tossed salad
Russian dressing
Sugar-free Jell-O, 1 cup
Whipped cream, 1 tablespoon

Typical Ongoing Weight-Loss Menu

Breakfast

Western Omelet:
 Eggs, 2
 Cheddar cheese, 2 ounces
 Bell peppers, 1 tablespoon
 Onion, 1 tablespoon
 Ham bits, 1/10 cup
 Butter, 1 tablespoon
Tomato juice, 3 ounces
Crispbread, 1 carbo grams (1/4 slice)
Tea, decaf, 8 ounces

Lunch

Chef's salad with ham, cheese, and egg with zero-carb dressing
Iced herbal tea, 8 ounces

Dinner

Subway seafood salad, 1 item
Poached salmon, 6 ounces
Boiled cabbage, 2/3 cup
Strawberries, 1 cup
Cream, 4 tablespoons

Typical Maintenance Menu**Breakfast**

Gruyere and spinach omelet:
Eggs, 2
Gruyere cheese, 2 ounces
Spinach, 1 cup cooked
Butter, 1 tablespoon
1 cantaloupe
Crispbread, 4 carbo grams (1 slice)
Coffee, decaf, 8 ounces

Lunch

Roast chicken, 6 ounces
Broccoli, 2/3 cup, steamed
Green salad
Creamy garlic dressing
Club soda

Dinner

French onion soup, 1 cup
Salad with tomato, onion, carrots
Oil and vinegar dressing
Asparagus, 1 cup
Baked potato, 1 small, with sour cream (2 tablespoons) and chives
Veal chops, 1 serving
Fruit compote, 1 generous cup)
Wine spritzer, 16 ounces

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