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Effect of Vegetarian Diets on Performance in Strength Sports

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A lacto-ovovegetarian diet can provide all the nutrients required for optimal health. Anecdotal reports suggest that many successful endurance athletes are vegetarians whereas few reports suggest that elite strength athletes follow a vegetarian diet. Strength and power athletes almost invariably include meat in their diets, although it is unclear whether the benefits of meat consumption for strength and power are real or imagined. KEYWORDS: nutrition, resistance training. Reprint pdf · Reprint doc

Definitions

Non-vegetarian or omnivore: eats foods of plant and animal origin, including meat, fowl, eggs, milk and other dairy products, and fish.
Lacto-ovovegetarian: eats predominantly foods of plant origin, with milk and other dairy products and eggs being the only foods of animal origin.
Vegan: eats foods only of plant origin.

Introduction

Last year a lively debate took place on the Sportscience mailing list about the effects of vegetarianism on sports performance, with particular reference to strength sports. The debate began with an assertion on a non-professional mailing list by a rock climber (who was not a nutritionist or physiologist) that a vegetarian diet is inferior to an omnivorous diet for the maintenance of strength and muscular endurance. He based this assertion on his personal experience and observations of other rock climbers. I sent this message to the Sportscience list for comment. Here is a summary of the debate, which I have updated with relevant references to published work and some additional issues. View the original messages by searching the list for *vegetarian* or viewing messages for June and July, 2001.

Arguments in Favor of the Vegetarian Diet

Bill Proulx (Appalachian State University, North Carolina), Stacey Sims (Massey at Wellington, New Zealand) and Deborah Shulman (address not provided) independently pointed out that from a nutritional viewpoint, vegetarian diets can provide all known essential nutrients in adequate quantities for strength training. Proulx went further and stated that a vegetarian diet might be expected to provide for *better* nutrition, with the exception of iron and zinc status. Janelle and Barr (1995) provided supporting evidence

for generally more nutritious diets (at least with respect to health) among vegetarian compared to non-vegetarian women. The vegetarians (n=23) had significantly higher intakes of carbohydrate, riboflavin, niacin, vitamin B_{12}, folate, vitamin C and ratio of polyunsaturated to saturated fat, and lower intakes of saturated fat than the nonvegetarians (n=22). However, of possible significance to strength sports, protein, zinc and copper intakes were significantly lower in the vegetarians.

Proulx sounded a note of caution in that the type of vegetarianism also needs to be considered. For example, a lacto-ovo-vegetarian diet might be expected to provide more protein, calcium and phosphorous than a vegan diet. However, in the study previously described, Janelle and Barr (1995) found no significant differences in levels of intake for protein or phosphorus between lacto-ovo-vegetarians (n=15) and vegans (n=8), while calcium intake was significantly lower in vegans. These authors also noted that there were fewer differences in nutrient intake between the non-vegetarian women and lacto-ovo-vegetarians than between the non-vegetarians and vegans. They concluded that the diets of their non-vegetarian subjects were approximately equivalent to those of the lacto-ovo-vegetarians, but noticeably different from those of the vegans.

Because the vegan diet is less common than the lacto-ovo-vegetarian diet, and it appears to be quite different to the non-vegetarian diet in terms of nutrient intake, this paper investigates possible differences only between non-vegetarian and lacto-ovo-vegetarian diets in relation to sports performance (especially strength sports). Consequently, unless otherwise indicated, in the remainder of this paper the term ‘vegetarian’ refers to people who are lacto-ovo-vegetarians.

The belief that a vegetarian diet can provide adequate nutrition, at least to fuel endurance running, is supported by the findings of Eisinger et al. (1994). Vegetarian runners and omnivorous runners taking part in a 1,000-km race over 20 days had their food provided. The foods were matched so that if all food was eaten, total energy (18.8 MJ) and percentages of energy derived from carbohydrate, fat and protein (60:30:10 respectively) would be identical between diets. Over the period of the study, energy, carbohydrate, fat and protein intakes did not differ between groups, but vegetarian runners had higher intakes of dietary fiber and poly-unsaturated fatty acids and a lower intake of cholesterol than the omnivorous competitors. Estimated vitamin and mineral intakes were also higher in vegetarian runners, except for sodium chloride and cobalamin (vitamin B12). Half the competitors in each group finished the race, and the type of diet was not predictive of finishing time. Although this study imposed a particular nutritional quality of diet on the vegetarian competitors—and therefore cannot be said to have been wholly self-selected—it did illustrate that a well-planned vegetarian diet is not necessarily associated with reduced endurance performance compared to a non-vegetarian diet.

Body Composition and Fitness of Vegetarians

Although it appears that vegetarian diets can provide adequate overall nutrient intake for endurance activity, specific components of the diet may have special importance in strength sports. For example, it is possible that in non-vegetarians, higher protein intakes, or protein specifically obtained from meat, leads to greater muscularity. Another possibility is that meat eating may lead to increased muscular hypertrophy in response to resistance training.

Several groups of researchers have addressed the issue of differences in body dimensions between vegetarians and omnivores. O’Connell et al. (1989) found that height of vegetarian children under 10 y was consistently lower than US reference values. However, Seventh Day Adventist children who had vegetarian diets did not differ substantially from their omnivorous peers in mean stature, weight, mid-arm circumference, triceps or biceps skinfold thickness, and weight-for-height (Tayter &

Stanek, (1989). The different findings in these two studies may derive from the inclusion of vegans in the former but not the latter study.

Hebbelinck et al. (1999) conducted anthropometric analyses (stature, weight, skinfold thicknesses), puberty ratings (where appropriate), and physical fitness (handgrip strength, standing long jump, sit-ups in 30 s, and heart-rate recovery following a step test) of vegetarian children, adolescents and young adults in the Netherlands. Compared to reference values…

- Vegetarian adolescents were of significantly lower stature, weight and body mass index, but there were no differences in stature or weight for the other age groups.
- Vegetarian children were of equal fitness, but vegetarian adolescents scored lower on standing long jump and 30-s sit-ups.
- Heart rate of vegetarian adolescents and young adults recovered substantially faster following the step test.

Hebbelinck et al. concluded that vegetarian adolescents and young adults performed better at the cardiorespiratory test, but the vegetarian adolescents scored lower on the strength and explosive power tests.

The possibility raised by the results of Hibbelinck et al.—that a vegetarian diet might actually lead to *improved* endurance performance compared to an omnivorous diet—was not supported in a review by Nieman (1999), who concluded that "some concerns have been raised about the nutrient status of vegetarian athletes, [but] a varied and well-planned vegetarian diet is compatible with successful athletic endeavor". Nieman conceded that strength athletes probably need more protein than the US RDA of 0.8 mg/kg. His suggestion was 1.4-1.8 mg/kg, but he stated that even "vegan athletes can achieve optimal protein intake by careful planning, with an emphasis on protein-rich plant foods such as legumes, nuts and seeds, and whole-grain products".

Nieman did point out one difference between omnivores and vegetarians of possible significance to performance in strength and explosive sports: intramuscular creatine concentration. Creatine in the form of creatine phosphate is a source of energy in high-intensity exercise. Depletion of creatine phosphate is a cause of fatigue in repeated bouts of such exercise, and possibly also in short-term endurance exercise. Vegetarians generally have less intramuscular creatine than omnivores (Maughan, 1995) because creatine is found only in muscle meat (providing an omnivore with about 1 g creatine per day), while the body itself produces a similar amount. Ironically, vegetarians may therefore derive greater benefit than omnivores from supplementation with creatine, but the benefit would presumably only make up for any lower level of performance in vegetarians before supplementation.

Does Meat-eating Benefit Strength Athletes?

In a message to the list, Andrew Campbell (Australia) argued that a vegetarian diet may actually be *less* nutritious than an omnivorous diet, because "egg yolk, butter and liver… are a rich source of the fat-soluble vitamins and minerals, including trace elements that bind to the fat molecules". With reference to mountain climbing, an activity that would appear to require both endurance and strength, Campbell suggested that a possible disadvantage of vegetarian diets is the high carbohydrate content, which "will cause problems to mountain climbers who have sensitive insulin balance. Short-chain fatty acids from butter provide energy without creating insulin swings." However, oxygen availability decreases with increasing altitude, so one possible *advantage* of carbohydrate over fat or protein to mountain climbers is a slightly higher return of energy for each mole of oxygen consumed.

Concern has also been expressed about a possible effect of high intake of phytoestrogens (e.g. isoflavones found in soy) on testosterone in male vegetarians. For example, Weber et al. (2001) found that soy phytoestrogens induced testosterone reduction in male rats. However, according to Kurzer (2002), "…recent studies in men consuming soyfoods or supplements containing 40-70 mg/d of soy isoflavones showed few effects on plasma hormones..." These data do not support concerns about effects on reproductive hormones."

Campbell and two other correspondents (Mathew Jordan from the University of Calgary and Mike Stone of Edinburgh University) were unaware of any vegetarians at the elite level of weightlifting, despite 30 years experience in Stone's case. No-one on the list offered any information about the prevalence of vegetarianism amongst female vs male strength athletes. Kathryn Russell (address not provided) argued that a perceived dearth of vegetarian weightlifters may not reflect a lack of effectiveness of the vegetarian diet for strength athletes; rather, the cultural/anthropological background of vegetarians may make them unlikely to take up strength sports.

Norrie Williamson (address not provided) argued that, rather than exerting a true anabolic effect, meat consumption may induce a placebo effect. That is, a strength athlete who believes that eating meat improves performance may receive a psychological boost that disappears if a vegetarian diet is adopted. Williamson (and many other subscribers) called for controlled studies on this issue, not more anecdotal evidence. Deborah Shulman suggested that at least 12 weeks would be needed for studies comparing the effects on performance at strength sports of nutrient-rich vegetarian diets with those containing meat.

Mike Stone pointed to evidence that strength-power athletes may need additional protein, which may be "easier" to obtain from animal sources. He also mentioned having seen unpublished data "indicating that testosterone concentration can be influenced by saturated fats in the diet (i.e., meat)". Russell countered by suggesting that if you remove from consideration those meat-eaters who also take dietary supplements, the pool of elite strength athletes might be markedly reduced; that is, the benefit may be coming from the supplements rather than the meat.

David Driscoll (Australia) conducted a brief review of the literature available through a website that provides information for people active in strength training and bodybuilding. This literature pushes the view that low meat/low saturated fat/high vegetable protein (e.g., soy) diets are associated with a marked reduction in testosterone (and, by implication, with reduced strength). Driscoll was not sure of the scientific quality of the information he found, and no-one on the list offered an assessment.

A more authoritative source of information is the paper by Campbell et al. (1999), who conducted a 12-week study to compare the effects of a vegetarian diet with an omnivorous diet on changes in body composition and skeletal muscle size in older men (51-69 y) in response to resistance training. There were substantial benefits for omnivores, who lost 6% fat mass, gained 4% fat-free mass, and increased Type II fiber area by 9% relative to the vegetarians. A trend towards higher total protein intake (self-reported) in the omnivores might explain the effects, but higher concentration of the anabolic hormone testosterone is more likely. Campbell et al. did not measure testosterone, but Raben et al. (1992) found higher testosterone in young men consuming a high-protein, meat-containing diet compared with those consuming a high-protein, vegetarian diet. If testosterone is involved, a difference in total protein intake per se would not account entirely for Campbell et al.'s findings, because Volek et al. (1997) showed an inverse relationship between protein intake and testosterone concentration.

The discussion on the mailing list went off on a tangent briefly when Bill Proulx claimed that many strength sport competitors are poorly informed about nutrition, while Matthew Jordan and Mike Stone argued that strength athletes, at least at the elite level, are well informed. Scott Naidus (address not provided) pointed out that nutrition is not a mature science, and that nutrient needs are not identical for every population group; in fact they differ even for individuals *within* each group. The existence of a plethora of dietary supplements with purported ergogenic effects only muddies the waters further. Naidus suggested that sound nutrition for the athlete is a balancing act between prepared foods and supplements vs fresh foods, and that this balance may vary from athlete to athlete.

Human Evolution and Dietary Need

Fabien Basset (Université Laval, Québec) introduced an evolutionary perspective, claiming that our closest relative, the chimpanzee, is largely vegetarian. An anonymous correspondent challenged this claim by reporting that 25 years of close study in the wild indicates that chimpanzees may actually have a preference for meat. However, Deborah Shulman pointed out that gorillas, which are larger and stronger than chimpanzees, are almost exclusively vegetarian.

The relevance of the eating habits of either chimpanzees or gorillas to human performance in strength sports is questionable. As the anonymous correspondent pointed out, hominids had several million years to evolve physiology and dietary needs different from those of the other great apes, so any parallels in eating habits may be coincidental. In this context, Andrew Campbell argued that the omnivorous diet is apparently the natural state for people: apart from those populations who embrace particular religious practices, no group is known to have deliberately avoided meat in their diet. Citing the impeccable source "educational television", Stephen Seiler (Agder University College, Norway) argued that, far from being essential, foods of plant origin may even be "optional extras". His evidence was a claim that the migrant Mongol people of the Eurasian Steppes "continue to live long, physically active lives on a diet of horse milk, blood and meat. They have never eaten fruit and vegetables, as no respectable Mongolian horseman wishes to be tied to the ground, tending crops." The claims about Mongol horsemen notwithstanding, all but one population of indigenous peoples studied to date have derived much, if not most of their energy from foods of plant origin (Kuhnlein and Turner, 1991). The exception is the Inuit, who nevertheless eagerly sought the few berries and other plant-derived foods that were available in the short Arctic growing period.

Researchers of the so-called paleolithic diet are divided over the importance of meat in providing adequate nutrition to our forebears. Eaton et al. (1997) and Cordain et al. (2000) argued that, in the absence of dairy and grain foods (the major sources of energy in the modern western diet), high meat intake was necessary to obtain adequate total energy. Nestle (1999) and Milton (2000) did not accept that meat intake was high throughout the paleolithic era. However, there appears to be general agreement that meat may always have been a component of the natural diet of *Homo sapiens*, but the majority of food eaten (at least in terms of total weight) was obtained from plants.

Bill Proulx did not accept the relevance of paleolithic diets to performance in strength sports; proponents of *the paleolithic diet argue almost exclusively for its (supposed) health benefits, but health and strength are different issues. Proulx pointed out that taking* steroids, mega-dosing with supplements, and consuming excess protein and fat are all activities that might be associated with improved performance in strength sports, but this will usually be at the expense of health. Proulx summarized his argument by stating that "there is no research supporting the necessity of meat in an athlete's diet and any such opinions are just that, opinions." Campbell's final comment was in the form of a

question to Proulx: "can you cite for me [any] studies showing that elite strength athletes perform just as well on a long term vegetarian diet?"

Conclusions

Some aspects of the discussion appear (at least to me) to have been resolved:

- There are several kinds of vegetarianism. Each could have a different effect on strength.
- There appears to be a preponderance of meat-eaters among strength athletes at the elite level. It is unclear whether this preponderance arose from noticeable benefits of meat consumption, a placebo effect of meat consumption, the confounding influence of supplement consumption, or some other cultural effect unrelated to any real benefit to performance.
- The diets of gorillas, chimpanzees and paleolithic humans cannot be relied on to indicate the optimal diet for health and fitness for people generally, or for athletes in strength sports.
- Well-planned vegetarian diets, particularly those including milk and/or eggs, can provide all essential nutrients for good health and for a high level of sports performance.
- The fact that vegetarian diets are associated with improved health outcomes compared to omnivorous diets does not necessarily imply that vegetarian diets are superior for performance in strength sports or any other strength-dependent activities.
- Indeed, in one recent study of resistance training in older males, omnivores had a bigger gain in muscle mass than vegetarians.
- If meat consumption does enhance strength, the mechanism could be increased testosterone synthesis (possibly through intake of saturated fat) or increased storage of creatine phosphate in muscle.
- More research is required!

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