



The effects of a vegetarian diet on dietary iron intake in adolescent female endurance athletes



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ABSTRACT

Iron is a key component for oxygen transport within the body. This makes it important for athletes, especially those in endurance events. Young women begin losing iron monthly through menstruation. Animal-based sources of heme iron are better absorbed than plant-based sources of nonheme iron. Considering all this, are vegetarian adolescent female cross country runners at risk of consuming inadequate amounts of iron than their non-vegetarian cohorts? Food Frequency Questionnaires (FFQ) and 3-Day Diet Logs (3DL) were given to 6 vegetarian and 15 non-vegetarian subjects. Intakes of iron and vitamin C, which aids iron absorption, were assessed using a scoring system (FFQ) and ESHA Research Solutions diet analysis software (3DL). Permutation tests were used to analyze the data. No significant differences in the average intakes of iron or any other key nutrients were found to exist between groups for 3DL data, but a commonly-attended running camp during the log period may have been a factor. Analysis of the FFQ dietary data revealed that vegetarians had statistically significantly higher intakes of vitamin C ($p = 0.0389$) and iron ($p = 0.0135$) than non-vegetarians.

INTRODUCTION AND HYPOTHESIS

IRON: Iron is incorporated into heme, which gives red blood cells the ability to transport oxygen in the body. Iron deficiency can decrease the oxygen-carrying capacity of the red blood cells. In anemia, the capacity is diminished to the point of declined physiological and cognitive performance. Athletes, especially those in endurance events, have greater requirements for oxygen.

ABSORPTION: Iron can be sourced from both plants and animal foods. Animal sources of iron are already incorporated into a heme molecule, making these sources more bioavailable. Plant sources, or non-heme, are less easily absorbed. Vitamin C acts as a promoter of iron absorption by keeping the iron in a more bioavailable, reduced form.

FEMALE ATHLETES: Female athletes have greater iron requirements due to blood loss via menstruation. Menstruation may be a new development for adolescent athletes, making iron intake an important monitoring point for these individuals.

RESEARCH QUESTION: Due to the intersecting points of interest outlined above, the effect of diet on iron intake was selected as a topic of scientific inquiry: Does a vegetarian diet impact the intake of iron in adolescent female endurance athletes?

HYPOTHESIS: Vegetarian female endurance athletes will have lower iron intake than their non-vegetarian cohorts.

METHODS

This study, which focused strictly on dietary intake, is part of a more detailed study that examines iron intake and iron status as reported from laboratory values. Food Frequency Questionnaires (FFQ) and 3-Day Diet Logs (3DL) were distributed to 6 vegetarian and 15 non-vegetarian subjects. The FFQ assessed monthly intakes of 25 different food and drink groups with defined serving sizes. Scores based on servings per week were assigned to the FFQ to create an estimate of each subject's daily iron and vitamin C intake. The 3DLs (actual reported food intake over a 3 day period) were analyzed using ESHA Research Solutions Food Processor Diet Analysis software to form a representative picture of each subject's nutritional intake, primarily focusing on iron and vitamin C. Small samples from non-normally distributed data prevented the use of the more common t-tests. Instead, permutation tests were used.

RESULTS

No significant differences in average iron intake or other key nutrients were found to exist between vegetarians and non-vegetarians for 3DL data. FFQ dietary data, representative of longer-term intakes, revealed that vegetarians had statistically significantly higher intakes of both vitamin C ($p < 0.05$) and iron ($p < 0.05$) than non-vegetarians.

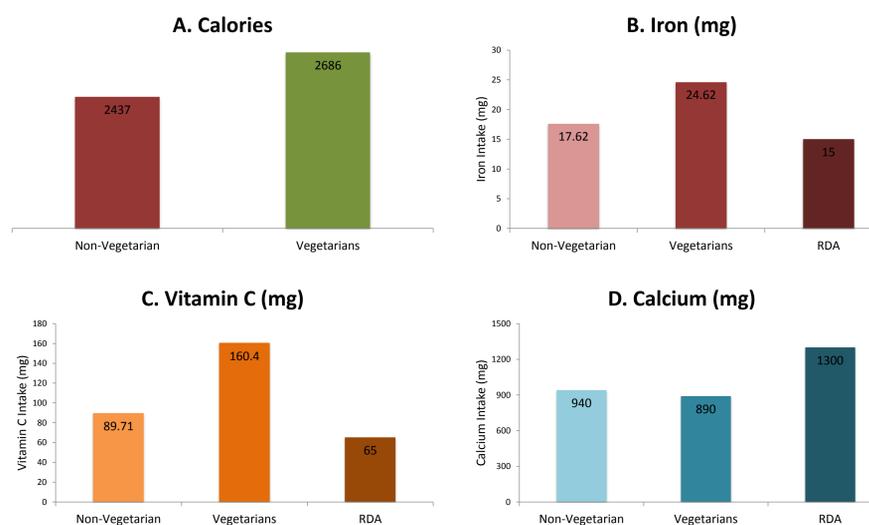


Figure 1. A-D: Average Intakes of selected nutrients for adolescent female cross country runners compared to RDA (where applicable). Data sourced from 3 day diet logs (3DL); no significant difference.

Table 1. Estimated daily intakes of iron and Vitamin C (Average \pm SD) reported by Food Frequency Questionnaire (FFQ).

Variable*	Non-Vegetarian ^a	Vegetarians ^b
Iron (mg)	14.15 \pm 6.26	22.90 \pm 7.28
Vitamin C (mg)	57.79 \pm 29.94	92.23 \pm 36.38

^a n=19 ^b n=6 * DRI reference values: Iron (15mg/day), Vitamin C (65mg/day)

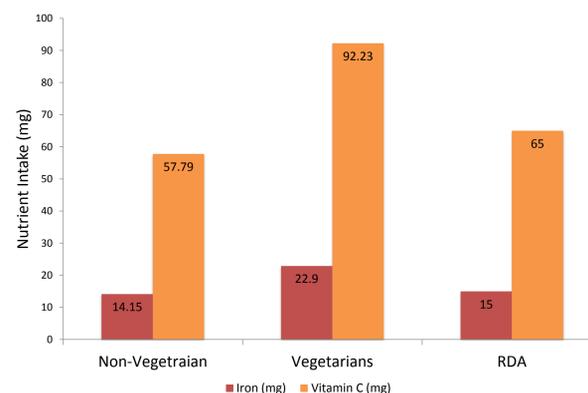


Figure 2. Average Intakes of selected nutrients for adolescent female cross country runners compared to RDA. Data sourced from Food Frequency Questionnaire (FFQ); significant difference found for both nutrients ($p < 0.05$).

DISCUSSION

- One vegetarian subject did not follow a strict vegetarian diet and reported via the FFQ occasional consumption of red meat, poultry, seafood, and fish.

- 3DL data showed no statistically significant differences between groups for any key nutrient intakes, possibly due to attendance of many subjects at the same running camp during the administration of the study.

- Vitamin C intake (65 mg/day RDA for 14-18 y.o. females) was higher for vegetarians than non-vegetarians (92 mg/day vs. 58 mg/day; see Figure 2). 33% of vegetarians did not meet RDA vs. 47% non-vegetarians.

- Iron intake (15 mg/day RDA for 14-18 y.o. females) was higher for vegetarians than non-vegetarians (23 mg/day vs 14 mg/day; see Figure 2). All vegetarians met RDA with one subject approaching the UL (45 mg/day) according to 3DL data. 66% of vegetarians met the RDA.

- It is recommended that vegetarians get 1.8 times the iron intake to account for low bioavailability of non-heme sources. This makes the adjusted RDA 27 mg/day, which 33% of vegetarians met.

- Only 17% of vegetarians and 20% of non-vegetarians consumed the RDA of calcium (1300 mg/day for 14-18 y.o. females) according to 3DLs.

CONCLUSION

- This study does not provide conclusive results about differences in iron intake between vegetarians and non-vegetarians.
- While it is possible for a vegetarian diet to meet the RDA standards, supplementation may be beneficial to ensure all micronutrient needs are met.
- Vegetarians should continue to consume adequate amounts of vitamin C to aid iron absorption.
- Calcium- and iron-containing foods or supplements should be consumed independent of each other to prevent absorption interference.
- Further research should quantify heme and nonheme intake and examine the iron status of subjects with blood testing.

REFERENCES

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