International Summit on Science Technology and Humanity
ISETH 2023
ISSN: 2807-7245 (online)

Nutrient Intake and Nutritional Status of Vegetarians Compared to Non-Vegetarians: A Systematic Literature Review

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Abstract

Purpose: A systematic literature review aims to analyze the nutritional intake and nutritional status among adult populations consuming vegetarian and non-vegetarian diets.
Methodology: This study employed a systematic literature review (SLR) of journals published from 2013 to 2023. Articles were sourced from the Pubmed, Scopus, and Google Scholar databases. Articles are included if eligible.
Results: The research posed specific research questions, and the findings indicated differences in nutrient intake and nutritional status between vegetarian and non-vegetarian populations. The nutritional intake and nutritional status of vegetarians showed better outcomes compared to non-vegetarians. However, dietary adjustments are necessary to ensure nutritional adequacy.
Applications/Originality/Value: A systematic literature review contributes to comparing nutrient intake and nutritional status vegetarians and non-vegetarians. Systematic literature review of this study compares several articles with different research objects, research samples, methods and results.

Introduction

Vegetarianism is a dietary pattern that prioritizes the consumption of plant-based products and vegetables while avoiding animal products. There are several types of vegetarianism practiced by the community, namely: (1) lacto-ovo vegetarian, who consumes plant-based products and only includes animal products such as eggs, milk, and other processed products; (2) lacto vegetarian, who consumes plant-based products and animal products in the form of milk; (3) ovo vegetarian, who consumes plant-based foods and animal foods in the form of eggs; and (4) vegan, who exclusively consumes pure plant-based products. The practice of vegetarian dietary patterns is rapidly growing, with many individuals adopting them for various reasons, one of which is health. The vegetarian diet, associated with health, is believed to prevent the risk factors of degenerative diseases such as hypertension, cancer, diabetes mellitus, and coronary heart disease (Pritasari et al. (2017); Richter et al. (2016)).

Vegetarian dietary patterns tend to involve low-fat, high-fiber, vitamin C, vitamin E, potassium, magnesium, folic acid, and high-carbohydrate intake. Excessive carbohydrate consumption in the vegetarian group is attributed to carbohydrates being used as the main energy substitute for fats found in animal-based foods. In contrast, non-vegetarian dietary patterns still include animal products such as eggs, milk, and their processed derivatives, which contain saturated fats and cholesterol (Sukmawati et al., 2021). According to Elorinne et al. (2016), vegetarian diets pose risks of deficiency in vitamin B12, vitamin D, iron, and calcium, as most of these nutrients are derived from animal products. Both vegetarian and non-vegetarian dietary patterns can influence nutritional status, which is tied to the selection of food items consumed. The choice of food items affects nutrient intake and adequacy levels. Habits of consuming vegetables and fruits, rich in vitamins and fiber, are among the factors influencing nutritional status. Additionally, the habit of consuming high-fat animal foods can impact nutritional status, while a high-fiber intake can reduce fat accumulation in the body (Anggraini et al. (2015); Astuti et al. (2019)).

Although a vegetarian diet is believed to have positive effects on health, it is crucial for the dietary pattern to remain balanced and diverse to ensure an adequate intake of nutrients in the body. Previous research indicates that vegetarian diets may pose a risk of deficiencies in vitamin B12, vitamin D, iron, zinc, and calcium, as these micronutrients are primarily found in animal products or have lower bioavailability in plant-based foods. Additionally, nutritional intake of EPA and

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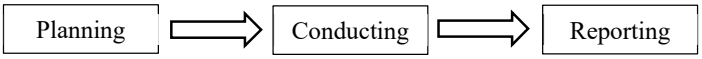
DHA, abundant in animal products like fish, may be insufficient in a vegetarian diet. Given this background, it is essential to evaluate the nutritional intake and nutritional status of vegetarians compared to non-vegetarians (Elorinne et al., 2016).

Therefore, the researchers aim to conduct a systematic literature review to assess the nutritional intake and nutritional status of adults following a vegetarian diet compared to those following a non-vegetarian diet.

Method

A systematic literature review is a method used to obtain evidence through a detailed and comprehensive process that starts with a strategic and transparent article search. This process is then followed by the identification, critical evaluation, and synthesis of all articles reporting study results related to the research question (Moenadjat et al., 2020). This research is the outcome of a previous article search that has undergone a selection process.
The stages in this research are as follows:



The research stages above consist of the planning stage, which is the initial phase of conducting an SLR. The conduction stage is the implementation phase of the SLR. The reporting stage involves transforming the SLR into a written report. The description of the stages above is explained as follows:

Preparing research questions

The formulation of research questions serves as a reference for determining which articles will be used. A relevant research question for this study is, "How do the nutritional intake and nutritional status of vegetarians compare to those of non-vegetarians?"
Article research is conducted using the criteria of the feasibility of article adoption adopting PICO (population, intervention, comparison, results) as follows: Population: adults aged 18 and above; Intervention: vegetarian diets, including vegan (excluding all animal products), ovo-vegetarian (limiting all animal products except eggs), lacto-vegetarian (limiting all animal products except milk), lacto-ovo-vegetarian (limiting all animal foods, including eggs and dairy products); Comparison: non-vegetarian diets; Results: nutritional intake and nutritional status.

Database search strategy

The articles were obtained from three electronic databases, including Pubmed, Scopus, and Google Scholar, to identify studies published in the last ten years between October 2013 and October 2023. The selection of these three databases aligns with the research objectives. The search keywords for the databases were as follows: '(nutrient intake OR macro-nutrients OR micro-nutrients) AND (nutritional status OR body mass index) AND (vegetarian OR vegan OR lacto OR ovo OR lacto-ovo) AND (non-vegetarian OR omnivore).

Evidence of research relevant to systematic strategies

In this stage, the literature obtained is then selected based on the following inclusion criteria:
a. Full-text articles published in the last 10 years (2013-2023).
b. Utilizing either Indonesian or English language.
c. The research subject is a population of adults aged 18 and above.
d. The intervention involves both vegetarian and non-vegetarian groups.
e. The research outcome includes nutrient intake and nutritional status.

Browsing research articles

Articles meeting the relevant criteria for the research topic, whether published or not, but meeting the inclusion criteria, will be examined.

Data extraction and synthesis of collected research evidence

This stage involves summarizing the data from the selected research articles in a simple table. The summary includes the title, author names, publication year, design, and relevant findings.

Preparing a report on the results of the systematic literature review

Researchers analyze, summarize, and organize relevant references to be reported in the results and discussion section.

Result

During the initial literature search, approximately 439 articles were found, comprising 45 articles from Pubmed, 115 articles from Scopus, and 279 articles from Google Scholar. During the initial review, 98 articles were identified that aligned with the review's scope. Subsequently, 10 out of the 98 articles were removed due to duplication, leaving 88 articles. Another 69 articles that did not meet the inclusion criteria were then removed, resulting in 19 qualifying articles. Fourteen articles were excluded because their findings did not support the research objectives. In the end, 5 articles were used for the review. The PRISMA flow diagram in Figure 1 illustrates the search strategy employed.

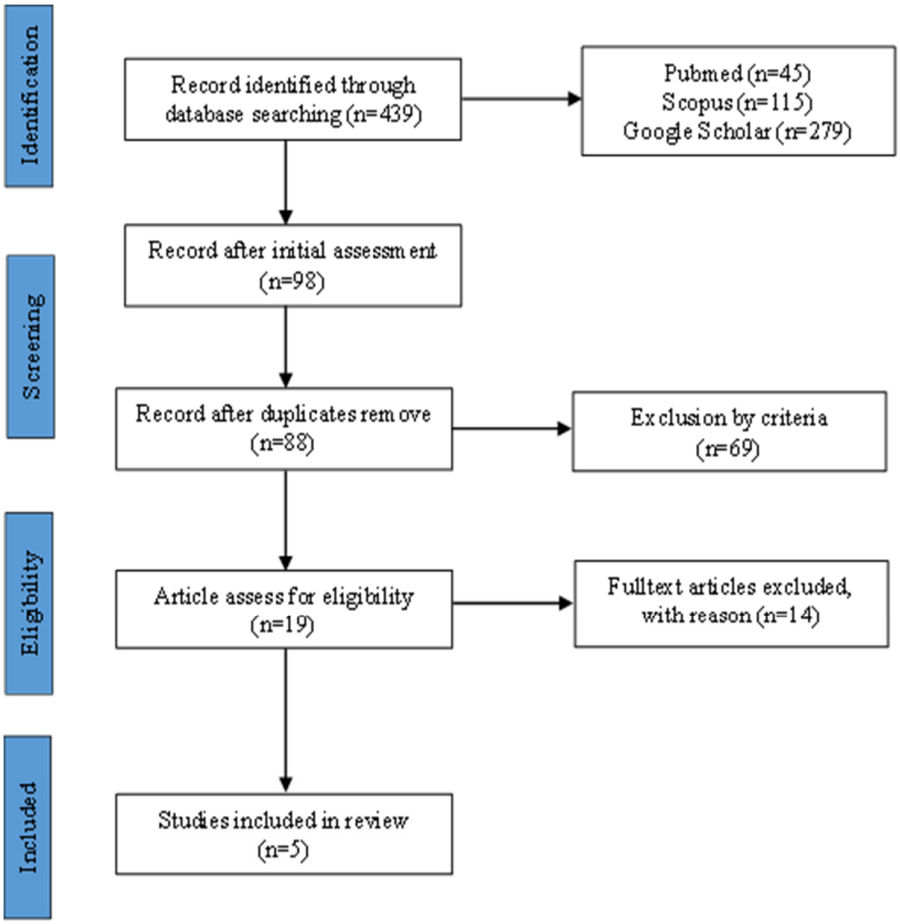


Figure 1. PRISMA flow chart

The summary of data extraction and synthesis of research evidence gathered from relevant reference articles on the research topic is presented in Table 1 below:

Table 1. Data Extraction and Synthesis of Collected Research

Title	Author, Year, Journal Name	Objectives	Design	Relevant Findings
Food and Nutrient Intake and Nutritional Status of Finnish Vegans and Non-Vegetarians	Elorinne et al. (2016), PLOS ONE	To compare dietary intake and nutritional status of Finnish long-term vegans and non-vegetarians	Cross sectional study	The nutritional intake of vitamin B12, vitamin D and iodine in vegans is lower than non-vegetarians.
Assessment of Nutritional Status and Health Condition Among Vegetarian and Non-Vegetarian Adult at Tangail Sadar Upazila in Tangail District	Akther et al. (2016), International Journal of Nutrition and Food Sciences	To analyze the nutritional status of vegetarians compared to non-vegetarians	Cross sectional study	The vegetarian group had good/normal nutritional status compared to non-vegetarians as seen through calculating body mass index The prevalence of underweight in the non-vegetarian group is higher than in vegetarian adults.
Comparing the nutritional status of vegetarians and non-vegetarians from a Buddhist Organisation in kuala Lumpur, Malaysia	Gan et al. (2018), Malaysian Journal of Nutrition	To analyze differences in nutritional status in terms of body weight and food intake between vegetarians and non-vegetarians	Cross sectional study	The vegetarian group has good nutritional adequacy compared to the non-vegetarian group, however, the vegetarian group must be aware of the possibility of deficiencies in vitamin B12, folate, calcium and niacin.
Comparison of nutritional status between lactoovo vegetarian and non-vegetarian Jordanian Adults	Al-Ma'aitah and Tayyem, (2021), Nutrition & Food Science	To analyze nutritional status through anthropometric measurements, macro and micronutrient intake between lacto-ovo vegetarians and non-vegetarians	Case control study	The lacto-ovo vegetarian group consumed higher amounts of fruit, vegetables and nuts in comparison non-vegetarian. Lacto-ovo vegetarian diet provides less intake of fat, saturated fat, monounsaturated fat and cholesterol as well as high fiber, folic acid, beta-carotene, vitamin C and vitamin K
Analisis perbedaan status gizi antara kelompok vegetarian dan non-vegetarian pada usia dewasa di Surabaya	Kano, (2023), Healthy Tadulako Journal	To analyze differences in nutritional status and nutritional intake between vegetarian and non-vegetarian groups in adulthood in Surabaya	Case control study	There is no significant difference in nutritional status between the vegetarian group and the non-vegetarian group in adulthood in Surabaya based on body mass index values for age (BMI/U) as well as carbohydrate, total fat and unsaturated fat intake

Based on the information provided in Table 1, the vegetarian group has successfully met the adequacy of carbohydrate, protein, iron, and vitamin B6 intake. However, zinc, folic acid, and vitamin B12 intake have not reached 80% of the

recommended daily allowance (RDA) compared to the non-vegetarian group. The article suggests that there is a difference in nutritional status between vegetarians and non-vegetarians due to dietary patterns and economic levels.

Discussion

The results of the literature analysis on nutritional intake and nutritional status of vegetarians compared to non-vegetarians can address the research question, where the nutritional intake of vegetarians and non-vegetarians has both advantages and disadvantages. The results of the literature analysis regarding nutritional intake indicate that the energy intake in vegetarian and non-vegetarian groups is the same. According to Elorinne et al. (2016), the total energy intake between vegans and non-vegetarians is also not different. Despite having a lower total energy intake, vegans are able to meet the recommended daily intake. Plant-based carbohydrates and proteins, such as soy, are the main sources of energy for vegans. Additionally, energy needs should be adjusted based on weight, gender, age, physical activity, and health status (Schmidt et al., 2013). Vegetarian groups, especially vegan vegetarians, have a lower intake of protein, fats, vitamin D, and vitamin B12 compared to non-vegetarian groups (Elorinne et al., 2016). The lower protein intake in the vegetarian group is because animal-based proteins are more easily digestible by the body and have a more complete content compared to plant-based proteins. The carbohydrate intake of the vegetarian group is lower because they consume fewer types, amounts, and frequencies of carbohydrate sources compared to the non-vegetarian group; one example is that vegetarians prefer consuming brown rice over white rice (Kano, 2023). However, the intake of fiber, PUFA, and total fatty acids is higher in the vegetarian group.

For micronutrient intake, vitamin B12 levels are lower in vegetarians, especially vegans, compared to non-vegetarians. The increased risk of vitamin B12 deficiency in vegetarians is due to the insufficient consumption of animal-based foods. Vegetarian groups can meet their vitamin B12 requirements from milk and eggs, especially lacto-ovo vegetarians. Additionally, vitamin B12 supplements are recommended for vegans or those who do not consume any animal products at all (Elorinne et al, (2016); Gan et al. (2018)). Vitamin D intake is lower in vegetarian groups, especially vegans, compared to non-vegetarian groups. Vitamin D naturally occurs only in animal-based foods such as fish, eggs, and meat. While vitamin D can also be obtained from sunlight exposure, this is limited in cold winter regions and for individuals with dark skin or limited sunlight exposure. Therefore, vegetarians are advised to meet their vitamin D intake by consuming vitamin D supplements (Al-Ma'aitah & Tayyem, (2021); Elorinne et al. (2016); Spiro & Buttriss, (2014)). According to Gan et al. (2018), calcium intake in vegetarians, especially lacto-ovo vegetarians, is higher than in non-vegetarians. In contrast, Al-Ma'aitah & Tayyem, (2021) suggest that calcium intake is higher in non-vegetarian groups compared to lacto-ovo vegetarians. This difference is because lacto-ovo vegetarians can consume milk as a source of calcium. Additionally, there are several plant-based foods rich in calcium, such as leafy green vegetables, legumes, and grains. However, calcium absorption can be hindered by phytates and oxalates present in plant-based foods. If the body has low levels of vitamin D, magnesium, and protein, calcium absorption will also be low, potentially leading to bone issues (Spiro & Buttriss, 2014). According to Al-Ma'aitah & Tayyem, (2021), zinc intake is higher in non-vegetarians because zinc intake is influenced by the phytate content in plant-based foods such as legumes and grains. However, the impact of phytate content can be reduced through methods like soaking, sprouting, fermentation, or even genetic modification of grains. Zinc is a crucial element in regulating the immune system, and insufficient zinc intake can lead to mental health disorders, with a higher risk observed in vegetarian groups (Sarikaya et al., 2023). Elorinne et al. (2016) state that there is no difference in iron intake between various types of vegetarians and non-vegetarians. However, vegetarian groups, especially women, have lower iron status and a higher prevalence of anemia compared to non-vegetarians. Non-vegetarian diets, consisting of animal-based foods like meat and fish containing heme iron, are more easily absorbed by the body than non-heme iron found in plant-based foods, whose absorption is inhibited by phytates and polyphenols. This lower bioavailability of iron in vegetarian diets suggests the need for 1.8 times higher iron intake. Additionally, iron absorption from plant-based foods can be enhanced by consuming fruits rich in vitamin C (Slywitch et al., 2021). On the other hand, vitamin E, vitamin B1, and vitamin C intake are higher in vegetarians compared to non-vegetarians. Good sources of vitamin B1 include grains and legumes, as well as meat and fish. Fruits and vegetables are the primary sources of vitamin C (Elorinne et al., 2016). Vegan vegetarian diets may not meet the recommended intake of zinc, iron, calcium, vitamin B12, and vitamin D, especially in women. Inadequate micronutrient intake can be addressed by consuming specific nutrient supplements (Kristensen et al. (2015); Henjum et al. (2023)). Both vegetarian and non-vegetarian diets carry the risk of nutrient deficiencies since some nutrients are found exclusively in plant-based or animal-based foods. Therefore, careful meal planning and regulation are essential to ensure the body's nutritional needs are met, with consideration for fortification or supplementation, especially for vegetarian groups (Pimentel C et al. (2019); Antoniazzi et al. (2022); Sarikaya et al. (2023)).

The results of the literature analysis on the nutritional status between vegetarians and non-vegetarians reveal a significant difference ($p = 0.60$) in nutritional standards between the two groups (Al-Ma'aitah & Tayyem, 2021). According to Gan et al. (2018), the nutritional status of the vegetarian group is lower than that of the non-vegetarian group. However, the high intake of animal-based protein affects weight gain in the non-vegetarian group. On the other hand, according to Kano, (2023), there is no difference in nutritional status between the vegetarian and non-vegetarian groups. Research subjects in both the vegetarian and non-vegetarian groups have normal nutritional status. This is related to the selection of foods consumed. The habit of consuming vegetables and fruits, which are rich in vitamins and fiber, is one of the factors influencing nutritional status. Additionally, the habit of consuming high-fat animal foods can affect nutritional status, while

a high fiber intake can reduce fat accumulation in the body (Astuti et al. (2019); Petermann-Rocha and Ho, (2023)). According to Rizzo et al, (2013), a high protein intake from meat is closely related to improved nutritional status in the non-vegetarian group. Akther e*t* al. (2016) suggest that the nutritional status of vegetarians is better than that of non-vegetarians because the vegetarian group consumes milk, legumes, and soy products for 1-3 days per week. Furthermore, nutritional status is also influenced by health factors, with 26% of vegetarians and 54% of non-vegetarians suffering from various diseases caused by poor hygiene and sanitation practices over 15 days. According to Jakše et al. (2021), a well-designed vegetarian diet has the potential to yield good nutritional status followed by a healthy lifestyle. In addition to food factors, the level of knowledge also becomes a factor influencing nutritional status. Individuals with extensive knowledge tend to be aware of health-related issues, allowing them to choose their food wisely (Cramer et al., 2017).

Based on the five reviewed articles, transitioning to a vegetarian diet can provide health benefits and increase the intake of nutrients such as fiber, PUFA (polyunsaturated fatty acids), folate, vitamin B1, vitamin B6, vitamin C, vitamin E, and magnesium. On the other hand, proper dietary management is necessary due to the risk of insufficient intake of protein, carbohydrates, EPA (eicosapentaenoic acid), DHA (docosahexaenoic acid), vitamin B12, vitamin D, calcium, iron, zinc, and iodine. These articles highlight the need for additional strategies, such as food fortification or supplementation, especially for nutrients that are challenging to obtain from a vegetarian diet. For example, vitamin B12 is not found in plant-based foods, and vitamin D and iodine are naturally present in specific foods. Supplementation is recommended as an alternative strategy to ensure nutritional needs are met. It is advised that both vegetarian and non-vegetarian groups broaden their knowledge about food sources of macronutrients and micronutrients to achieve a balanced diet. Attention to the variety of foods consumed is emphasized to prevent nutritional deficiencies and ensure the intake of necessary nutrients. Adequate nutritional intake can influence nutritional status and it is also hoped that maintaining a healthy lifestyle will help keep nutritional status within normal limits.

Conclusion

There are nutritional deficiencies observed in both vegetarian and non-vegetarian groups. The vegetarian group tends to have a lower nutritional intake of vitamin B12, vitamin D, calcium, and iron compared to the non-vegetarian group. Additionally, the non-vegetarian group is at risk of deficiencies in vitamin C, vitamin B1, and vitamin B6. The findings of this review underscore the need for additional strategies to help regulate a more nutritionally balanced and sustainable dietary pattern. This can be achieved through education on the diversity of plant-based foods, food fortification, and supplementation. The nutritional status differences between vegetarian and non-vegetarian groups, as highlighted in this review, are influenced by food choices, knowledge levels related to nutrition, socioeconomic factors, and sanitation practices.

Acknowledgement

The author would like to thank Universitas Muhammadiyah Surakarta for facilitating the completion of this article.

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