REVIEW

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The relation between the diet and the diverticulitis pathophysiology: an integrative review

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ABSTRACT – Background – Diverticulitis is an acute inflammatory process that affects individuals with diverticular disease. Given the sharp increase in the diagnostic rate of such a pathological process, there was also an increased interest in elucidating the possible causes related to the development of this clinical condition. Among the main factors investigated, diet excels, the object of study of this integrative literature review. **Methods –** After searching the virtual health library and PubMed databases, five prospective cohort studies were selected that best answered the guiding question: "Is there a relationship between diet and the incidence of diverticulitis?". **Results –** It was observed that the high intake of red meat and the low intake of dietary fiber were the most strongly associated dietary factors with the incidence of this inflammatory process. **Conclusion –** Therefore, it is evident that choosing healthy eating habits can considerably reduce the incidence of diverticulitis and, consequently, potentially more serious complications directly related to it.

Keywords – Diverticulitis; diet; dietary fiber; red meat; risk factor.

INTRODUCTION

Diverticulitis is the most common clinical complication of diverticular disease, affecting 10–25% of patients with this pathology[1]. Small lumen pockets, primarily from the colon region in the large intestine, herniation of the mucosa over the inner lining layer, and at the vascular injury sites that characterize a diverticular disease, undergo an inflammatory process resulting in diverticulitis. Bacterial proliferation at these sites can lead to rupture of the innermost tissue and extensive damage across the entire thickness of the intestinal wall[2]. Despite being uncommon, the formation of abscesses may occur depending on the extent and location of the vascular lesion, causing herniation and severity of the inflammatory action, resulting in other serious complications[3], such as peritonitis.

The incidence of diverticulitis increased by 50% between the years 2000–2007, compared to 1990–1999[4]. Parallel to this increase, the high diagnostic rate of diverticulitis in hospitals in the United States exists, which is one of the main gastrointestinal disorders registered in the country[5]. Although previous research claims that 20% of people affected by diverticular disease develop diverticulitis[6], a more recent prospective study found that the chance of this evolution would be only 4%[7]. However, further studies are necessary to confirm this hypothesis.

The recurrence of this gastrointestinal disorder generally has a high frequency; however, in most cases, there are no complications. Younger people with diverticulitis have less severe diseases, a higher number of recurrences, and better survival[4]. In this context, the high geographical and temporal variability presented by the prevalence of diverticular disease led to the hypothesis that high incidence and subsequent recurrence are associated with conditions determined by factors such as diet and lifestyle[8]. To prove this hypothesis, some studies have suggested evidence of the disease pathogenesis, assuming that this pathology is directly associated with an inappropriate diet, both due to the deficiency of some foods, such as dietary fibers, as well as the excess of others, such as red meat[9,10]. Supporting this idea, data found in a cross-sectional analysis confirmed lower rates of diverticular disease among vegetarians[11].

Despite its wide reiteration and the range of clinical consequences caused by diverticulitis, there are no in-depth investigations to date that have elucidated the exact mechanisms underlying the observed associations. Thus, data related to the etiopathogenesis of this disease require further evidence[12]. In this regard, with a relatively low rate of studies that sought to obtain some evidence about such relations, this study aimed to review the literature on the occurrence of diverticulitis associated with eating habits.

METHODS

It was an integrative systematic review conducted to answer the following guiding question: "Is there a relationship between diet and the incidence of diverticulitis?". The databases searched were PubMed (Digital Biomedical Archives and Health Sciences of the National Institutes of Health in the United States) and virtual health library (VHL). The research was carried out using the descriptors: "diverticulitis", "diet" and "risk factor" in English; and "diverticulite", "dieta" and "fatores de risco" in Portuguese, adapted according to the database. The identification of the studies was initially carried out through the analysis of titles and abstracts, with subsequent reading and detailing of the full texts of the potentially eligible studies.

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The inclusion of the studies was based on the following criteria: studies with high methodological accuracy that evaluated the relationship between diet and incidence of diverticulitis, including men and/or women without restrictions on age, race, and color. The exclusion criteria were as follows: studies that did not answer the guiding question, studies with low methodological accuracy, review articles, editorials, letters, guides, and clinical guidelines (FIGURE 1).

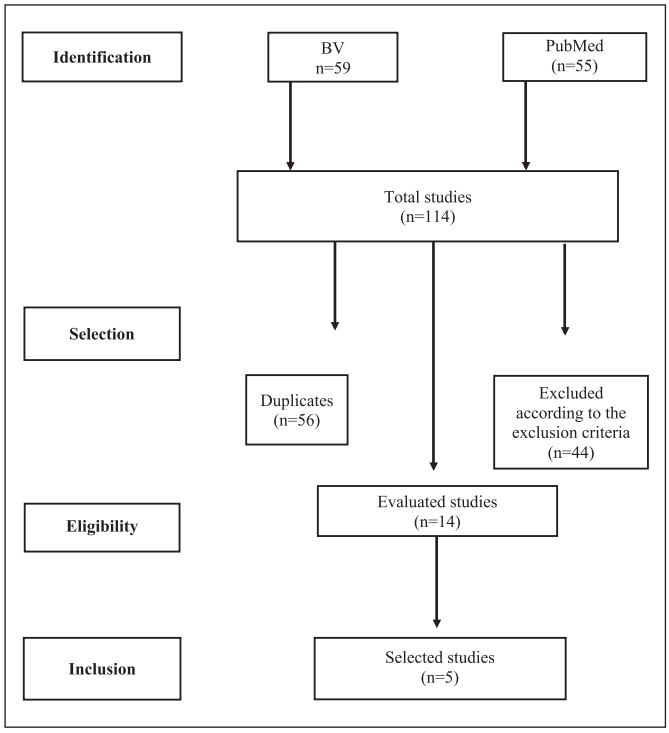

FIGURE 1. Flowchart representative of the inclusion and exclusion criteria of the selected articles.

The data collection of those found in the bibliographic search was performed using an instrument in the form of a questionnaire, validated by Ursi. This instrument encompasses the goals of the research, characteristics of the sample, results, and implications of the results. Subsequently, the academic advisor was consulted to ensure the methodological quality of the selected studies. The studies were finally selected by the authors of this study along with the academic advisor, who together did a critical evaluation of all eligible articles to identify possible biases. At the end of the study, five articles were included in the review.

The articles were chronologically organized with their respective authors, year of publication, title, type of study, country, number of participants, and summary of results (TABLE 1). As for language and country of origin, all articles (n=5) were published in the English language and conducted in the United States.

RESULTS

A total of 114 studies were found in the VHL and PubMed databases, and 56 duplicates were excluded. Among the remaining 58 titles, 44 were excluded according to previously defined exclusion criteria. The remaining 14 titles were evaluated, and from these, five articles were selected[13-17]. All selected studies were prospective cohorts, involving a large number of participants, ranging from 45,203 to 50,019 people, with long follow-up periods of 18–26 years of the study population. In all the studies, the sample consisted of American health professionals. The study sample by Ma et al.[15] was formed exclusively by women, aged between 43 and 70 years, and in the other studies, it was formed exclusively by men aged between 40 and 75 years.

The study by Liu et al.[13], which included 45,203 participants, all-male health professionals, listed lifestyle habits with the development of diverticulitis. It was reported that a high intake of red meat, low consumption of dietary fiber, the low performance of an intense physical activity, high body mass index (BMI), and smoking were independently associated with an increased risk of diverticulitis (P<0.05). The low-risk lifestyle was defined as mean

TABLE 1. Description of the five articles included in the review in chronological order with information from the authors, year of publication of titles, type of study, country, number of participants (N) and summary of results.

Authors (year)	Original article title	Type of study, country and number of participants (N)	Summary of the results
Strate LL, Liu YL, Syngal S, Aldoori WH, Giovannucci EL. (2008)	Nut, corn, and popcorn consumption and the incidence of diverticular disease.	Prospective cohort, United States and N=47,228.	The consumption of nuts, corn and popcorn did not increase the risk of diverticulitis.
Strate LL, Keeley BR, Cao Y, Wu K, Giovannucci EL, Chan AT. (2016)	Western dietary pattern increases, and prudent dietary pattern decreases, risk of incident diverticulitis in a prospective cohort study.	Prospective cohort, United States and N=46,295	The association between dietary patterns and diverticulitis was predominantly attributable to the intake of fiber and red meat.
Cao Y, Strate LL, Keeley BR, et al. (2017)	Meat intake and risk of diverticulitis among men.	Prospective cohort, United States and N=46,461	The red meat intake, especially unprocessed meat, was associated with an increased risk of diverticulitis.
Liu PH, Cao Y, Keeley BR, et al. (2017)	Adherence to a healthy lifestyle is associated with a lower risk of diverticulitis among men.	Prospective cohort, United States and N=45,203	Adherence to a low–risk lifestyle can prevent 50% (95%CI: 20–71%) of incident diverticulitis.
Ma W, Nguyen LH, Song M, et al. (2019)	Intake of dietary fiber, fruits, and vegetables and risk of diverticulitis.	Prospective cohort, United States and N=50,019	The higher intake of total dietary fibers is associated with a lower risk of diverticulitis. Intake of whole fruits is also associated with reduced risk.

intake of red meat <51 gm per day, dietary fiber intake of approximately 23 gm per day, intense physical activity of approximately 2 h weekly, normal BMI between 18.5 to 24.9 kg/m², and no smoking. There was an inverse linear relationship between the number of low-risk lifestyle factors and incidence of diverticulitis (P<0.001); therefore, it was found that following a low-risk lifestyle could reduce the incident diverticulitis by 50% (95% confidence interval [CI], 20–71%). The relationship between each risk factor and the development of diverticulitis was also analyzed. For participants with a high intake of red meat, an increased risk of developing diverticulitis was observed (multivariable relative risk [RR], 1.43; 95%CI, 1.10–1.85) when compared to those who consumed less. As for dietary fiber, people with the highest consumption had a reduced risk of developing diverticulitis compared to people with lower consumption, with a multivariable RR of 0.77 (95%CI, 0.60–0.98). For participants who performed physical activity with high intensity compared to those who did not have this habit, a multivariable RR of 0.73 (95%CI, 0.58–0.92) was detected. Obese men (a minimum BMI of 30 kg/m²) had a multivariable RR of 1.21 (95%CI, 0.97–1.49) for diverticulitis when compared to those who had a normal BMI, and, finally, smoking participants (≥40 pack-years) had an RR of 1.27 (95%CI, 1.01–1.58) when compared to those who never smoked.

In addition, establishing a measure of association given this outline, the study by Strate et al.[14] included 46,295 people in their study and established two main dietary patterns, the western and prudent. The Westerner pattern is characterized by high consumption of red and processed meat, refined grains, sugar desserts, French fries, and high-fat dairy products. In contrast, the prudent pattern is characterized by high consumption of fruits, vegetables, whole grains, vegetables, poultry, and fish. The 2010 Alternate Healthy Eating Index (AHEI, 2010) was also calculated, which represents the ideal eating behavior for disease prevention and has a score on 10 dietary components (vegetables, fruits, nuts, vegetables, red meat, trans fat, polyunsaturated fat, long-chain fats, whole grains, sugary drinks, fruit juices, and alcohol). It was observed that men with mostly Western eating habits had a multivariable RR of 1.55 (95% CI,1.20–1.99) for the development of diverticulitis. For men who maintained a predominantly prudent dietary pattern, a multivariable RR of 0.74 (95%CI, 0.60–0.91) was observed for the development of diverticulitis. For those who presented the closest to ideal eating behavior, according to AHEI-2010, a multivariable RR was found to be 0.67 (95%CI, 0.55–0.82).

Achieving more evidence regarding the relationship between diet and diverticulitis, the study of Ma et al.[15], developed with 50,019 American nurses, found an association between dietary fiber intake and the risk of developing diverticulitis. Women with a higher intake of total fibers had a multivariable RR of 0.86 (95%CI, 0.78–0.95). For cereal fibers, women with higher consumption had an RR of 0.90 (95%CI, 0.81–0.99). For fruit fibers, an RR of 0.83 (95%CI, 0.75–0.92) was found for the participants who ate the greatest amount. Finally, women with higher consumption of vegetable fiber had an RR of 0.92 (95%CI 0.83–1.01). It was also observed that women who ingested 25 gm/day or more of total fibers, when compared to those who consumed less than 18 g/day, presented a multivariable RR of 0.87 (95%CI, 0.79–0.96). Another important finding of the study was that the total intake of whole fruits was associated with a reduced risk of diverticulitis (multivariable RR of 0.95; 95% CI; 0.92–0.98 for each increase in the portion of the total consumption of whole fruits per day). In the evaluation of individual fruits, it was found that the increased intake of apples or pears (RR 0.85; 95%CI, 0.76–0.96) and plums (RR 0.83; 95%CI, 0.69–0.99) had a significant relationship with a lower risk of diverticulitis, regardless of the total intake of whole fruits. In contrast, it was observed that the consumption of fruit juice and the increase in the intake of vegetables had no significant relationship with the development of diverticulitis. It is important to note that insoluble fiber (RR 0.86; 95%CI, 0.78–0.95) showed a greater association with the risk of diverticulitis compared to soluble fiber (RR 0.95; 95%CI, 0.86–1.05. Finally, the relationship between potato intake and the risk of diverticulitis was determined. It was found that the intake of roasted or mashed potatoes was related to an increased risk of diverticulitis (for each increase in the portion of intake per day, the RR was 1.20, 95%CI, 1.07–1.36); however, no association was found between diverticulitis and the consumption of French fries.

Another study that further evidenced the strong association between diet and the inflammatory process of diverticula was that of Cao et al.[16], comprising 46,461 participants, which related meat intake to the development of diverticulitis. Men with a high total consumption of red meat independent, had a multivariable RR of 1.58 (95%CI, 1.19–2.11). It was observed that for each serving of meat consumed per day, the risk of developing diverticulitis increased by 18%, reaching a plateau after six portions per week. The main association was for the consumption of unprocessed red meat, with a modified RR of 1.51 (95%CI, 1.12–2.03), while the intake of processed red meat showed an RR of 1.03 (95% CI, 0.78–1.35). There was no association between higher consumption of poultry or fish with the development of diverticulitis.

Finally, to clarify the paradigms experienced in clinical practice regarding the relationship between nut/chestnut, popcorn, and corn intake with the development of diverticulitis. The study by Strate et al.[17] comprising 47,228 male health professionals, observed that men with higher consumption of nuts/chestnuts (at least twice a week) compared to those with lower consumption (less than once a month), had an RR of 0.80 (95%CI, 0.63–1.01). For men with higher consumption of popcorn (at least twice a week) than those with lower consumption (less than once a month), an RR of 0.72 (95%CI, 0.56–0.92) was noted. Therefore, an inverse relationship was found between the consumption of nuts/chestnuts, and popcorn with the risk of developing diverticulitis. No association was observed between corn consumption and diverticulitis.

Moreover, although it was not the main focus of the study, the relationship between the consumption of strawberries and blueberries with the development of diverticulitis was analyzed, comparing men who consumed at least twice a week to men who consumed less than once a month, and no significant association was found. (RR 0.87, 95%CI, 0.65–1.16). Despite the observations, more research is necessary to clarify precisely the relationship between the consumption of seeds and development of diverticulitis.

DISCUSSION

The increase in the incidence of diverticulitis in recent years has a major impact on the lives of patients and health systems, requiring large investments in the diagnosis and treatment of this pathology. Existing research shows that the development of diverticulitis and its recurrence is multifactorial in origin, with a diet closely related to the acute inflammatory process. The large prospective cohort studies selected as the bibliographic basis for this review indicate the high

intake of red meat and low intake of fiber as the main dietary factors related to the development of diverticulitis. Furthermore, the results found regarding the consumption of nuts/chestnuts, and popcorn induce an expansion of the general view on the pathology and a change in the routine recommendations of the clinical environment, which for many years defended the partial or total removal of these foods from the patients' daily lives affected by this disease.

In addition to the studies included in this review, other studies have identified several risk factors with a positive association in the development of this inflammatory process, including medications, genetic factors, smoking, obesity, sedentary lifestyle, alteration of intestinal microflora, age, among other less significant conditions[4,13,18-24]. Despite the increase in research on this disease, guiding new paths regarding its approach and treatment, the understanding of the pathogenesis of diverticulitis is still superficial. The interventions performed regarding the treatment are made mainly by the use of antibiotics, diet modification, and surgical resection, depending on the severity of the case. Such measures adopted are based predominantly on the conception of specialists as there is a lack of concrete evidence about the entire pathological process that prevents the validation of an effective standard treatment.

Some biases can be listed in the selected studies, leading to some limitations of the studies: (1) The samples involved only American health professionals, making it impossible to indiscriminately generalize the results. However, as it was a heterogeneous population, this bias was minimized. (2) The participants were monitored using retrospective self-questionnaires. Despite possible errors in the reports made, the results did not show significant interferences, and several other studies were found that reinforced the observations by the researchers. (3) The study was observational. This was attenuated by the fact that the follow-up time was quite long, ranging from 18 to 26 years, and by a wide sample, giving greater reliability to the observed results. (4) Even with the necessary adjustments of several variables for the data analysis, a possibility of residual confusion exists. Despite the limited number of eligible primary studies for more systematic analysis and the possible present biases, this review allows us to identify that eating patterns and lifestyle habits can act jointly and/or independently to intervene in the risk of diverticulitis incidence.

Authors' contribution

Lemes V: conceptualization, investigation, methodology, writing-original draft. Galdino GG: conceptualization, investigation, methodology, writing-original draft. Romão P: writing-review & editing, Reis ST: conceptualization, project administration, supervision.

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RESUMO – Contexto – A diverticulite é um processo inflamatório agudo que afeta indivíduos com doença diverticular. Diante do acentuado aumento da taxa diagnóstica desse processo patológico, também houve o aumento do interesse em elucidar as possíveis causas relacionadas ao desenvolvimento dessa condição clínica. Entre os principais fatores investigados, destaca-se a dieta; objeto de estudo desta revisão integrativa da literatura. **Métodos –** Após pesquisa nas bases de dados da biblioteca virtual em saúde e PubMed, foram selecionados cinco estudos de coorte prospectivos que melhor responderam à questão norteadora "Há relação entre dieta e incidência de diverticulite?". **Resultados e Conclusão** – Observou-se que o alto consumo de carnes vermelhas e o baixo consumo de fibra alimentar são os fatores dietéticos mais fortemente associados à incidência desse processo inflamatório. Fica evidente, portanto, que a escolha de hábitos alimentares saudáveis pode reduzir consideravelmente a incidência de diverticulite e, consequentemente, de possíveis complicações mais graves diretamente relacionadas a ela.

Palavras-chave – Diverticulite; dieta; fibra dietética; carne vermelha; fator de risco.

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