PUCHAŁA, Justyna, BASIURA, Karolina, STARZOMSKA, Dominika, GAJDZIŃSKA, Natalia, RYMASZEWSKA, Katarzyna, ROSTKOWSKA, Weronika, SALWA, Adam, RUTKOWSKI, Wojciech, RZEPKA, Maciej and SZTUBA, Karolina. Is there a link between gastroesophageal reflux disease and physical activity? Quality in Sport. 2024;16:52674. eISSN 2450-3118.
https://dx.doi.org/10.12775/QS.2024.16.52674
https://apcz.umk.pl/QS/article/view/52674

The journal has had 20 points in Ministry of Higher Education and Science of Poland parametric evaluation. Annex to the announcement of the Minister of Higher Education and Science of 05.01.2024. No. 32553.
Has a Journal's Unique Identifier: 201398. Scientific disciplines assigned: Economics and finance (Field of social sciences); Management and Quality Sciences (Field of social sciences).
Punkty Ministerialne z 2019 - aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 r. Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398.
Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych).

The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 16.06.2024. Revised: 20.06.2024. Accepted: 03.07.2024. Published: 10.07.2024.

Is there a link between gastroesophageal reflux disease and physical activity?

Justyna Puchała, Karolina Basiura, Dominika Starzomska, Natalia Gajdzińska, Katarzyna Rymaszewska, Weronika Rostkowska, Adam Salwa, Wojciech Rutkowski, Maciej Rzepka, Karolina Sztuba

Justyna Puchała
ORCID 0009-0002-6155-6670
https://orcid.org/0009-0002-6155-6670
Independent Public Health Care Institute of the Ministry of Internal Affairs and Administration in Katowice, ul. Wita Stwosza 41, 40-514 Katowice

Karolina Basiura
ORCID 00009-0002-2680-4114
https://orcid.org/0009-0002-2680-4114
2nd Speciality Hospital in Bytom, ul. Stefana Batorego 15, 41-902 Bytom, Poland

Dominika Starzomska
ORCID 0009-0006-1607-2502
https://orcid.org/0009-0006-1607-2502
Independent Public Health Care Institute of the Ministry of Internal Affairs and Administration in Katowice, ul. Wita Stwosza 41, 40-514 Katowice

Natalia Gajdzińska
ORCID 0009-0009-1072-2895
https://orcid.org/0009-0009-1072-2895; gajdzinska.natalia@gmail.com
Independent Public Health Care Institute of the Ministry of Internal Affairs and Administration in Katowice,
ul. Wita Stwosza 41, 40-514 Katowice, Poland

Katarzyna Rymaszewska
ORCID 0009-0006-1848-1991
https://orcid.org/0009-0006-1848-1991
Independent Public Health Care Institute of the Ministry of Internal Affairs and Administration in Katowice,
ul. Wita Stwosza 41, 40-514 Katowice

Weronika Rostkowska
ORCID 0009-0009-3759-9989
https://orcid.org/0009-0009-3759-9989; weronika.rostkowska97@gmail.com
Narutowicz City Speciality Hospital at Krakow, ul Prądnicka 35-37; 31-202 Kraków

Adam Salwa
ORCID 0009-0009-2534-7872
https://orcid.org/0009-0009-2534-7872; asalwa97@gmail.com
Independent Public Health Care Institute of the Ministry of Internal Affairs and Administration in Katowice,
ul. Wita Stwosza 41, 40-514 Katowice, Poland

Wojciech Rutkowski
ORCID 0009-0004-7393-4231
https://orcid.org/0009-0004-7393-4231; worutkowski@gmail.com
Leszek Giec Upper-Silesian Medical Centre of the Silesian Medical University in Katowice
ul. Ziołowa 45 / 47, 40-635 Katowice

Maciej Rzepka
ORCID 0009-0009-9005-817X
https://orcid.org/0009-0009-9005-817X
ST. BARBARA SPECIALIZED REGIONAL HOSPITAL No.5,
Medyków Square 1, 41-200 Sosnowiec, POLAND

Karolina Sztuba
ORCID 0000-0003-4987-3833
https://orcid.org/0000-0003-4987-3833
SPZOZ District Railway Hospital in Katowice

Corresponding author
Justyna Puchała
ORCID 0009-0002-6155-6670
https://orcid.org/0009-0002-6155-6670
Independent Public Health Care Institute of the Ministry of Internal Affairs and Administration in Katowice,
ul. Wita Stwosza 41, 40-514 Katowice

Abstract

Aim of study

The purpose of this review is to examine the impact of physical activity on the course of gastroesophageal reflux disease (GERD) and to provide an overview of the disease based on current literature.

Materials and Methods

A comprehensive literature search was conducted using the Medline/PubMed database to identify relevant studies. Additionally, reference lists of included articles were manually searched to identify further relevant studies. Data extraction was performed independently by two reviewers using a standardized form.

Results

GERD is a chronic condition characterized by the reflux of stomach contents into the esophagus, affecting an estimated 20% of the global population. Pathophysiological mechanisms include transient lower esophageal sphincter relaxation, hiatal hernia, and delayed gastric emptying. Physical activity has a dual impact on GERD; while moderate exercise can aid in symptom management by promoting weight loss and improving gastric emptying, high-intensity activities may exacerbate symptoms due to increased intra-abdominal pressure.

Conclusions

GERD is a prevalent chronic condition that significantly impacts quality of life. Effective management requires a multifaceted approach, including lifestyle modifications, pharmacotherapy, and in severe cases, surgical intervention. Moderate physical activity can be beneficial for symptom management, but high-intensity exercise may worsen symptoms. Health professionals should emphasize patient education and tailored treatment strategies to improve outcomes for GERD patients.

Keywords: Gastroesophageal reflux disease, Non- Erosive Gastroesophageal reflux disease, Erosive Esophagitis, Physical activity

Introduction

Gastroesophageal reflux disease (GERD) is a chronic condition where stomach contents, including acid and enzymes, flow back into the esophagus. It is a widespread problem worldwide, with an estimated 20 % of the population suffering chronically from its occurrence, making treatment of it a daily problem faced by GPs and specialists alike. There are three most common types of reflux disease and its complications: erosive esophagitis (EE), non-erosive reflux disease (NERD), and Barrett's esophagus (BE) (1). In terms of the prevalence of each type, NERD is the most common, being a manifestation of approximately 60-70% of all forms of reflux disease(2). There are reports of an increased risk of both esophageal and oropharyngeal and laryngeal cancers in patients exposed to reflux disease, making its diagnosis and treatment an extremely important therapeutic issue (3). Fortunately, there are effective treatments available, ranging from pharmacological methods led by PPIs to surgical anti-reflux operations (4).

Aim of study

The purpose of this work is to discuss, on the basis of the available literature data, the effect of physical activity on the course of GERD, as well as the available data on the disease itself. This review aims to make health professionals aware of the importance of proper education of the patient with the disease, as well as its proper treatment.

Materials and methods

A comprehensive literature search was conducted using Medline/PubMed database to identify relevant studies. The search strategy included the following keywords: Gastroesophageal reflux disease, Non- Erosive Gastroesophageal reflux disease, Erosive Esophagitis, Physical activity. Additionally, reference lists of included articles were hand-searched to identify any further relevant studies. Data were extracted independently by two reviewers using a standardized form.

Results of review

Pathophysiology of gastroesophageal reflux disease

The lower esophageal sphincter (LES), a muscular ring at the junction of the esophagus and stomach, normally prevents such reflux by tightening. However, in GERD, the LES may weaken or relax inappropriately, allowing gastric contents to move upwards. Key mechanisms of GERD include transient LES relaxation (TLESR), where the LES relaxes in response to triggers like gastric distention or certain foods.(5) This relaxation permits reflux into the esophagus. Hiatal hernia, where part of the stomach protrudes through the diaphragm into the chest cavity, can also contribute by disrupting the barrier function of the LES (6).Impaired esophageal clearance mechanisms, such as reduced peristaltic contractions or saliva production, can prolong exposure of the esophageal lining to acidic stomach contents. Conditions like delayed gastric emptying (gastroparesis) can further exacerbate GERD symptoms by increasing the volume and acidity of refluxed material (5,6).

Epidemiology of gastroesophageal reflux disease

Understanding the epidemiology of gastro-esophageal reflux disease (GERD) worldwide is important for several reasons. It enables and helps to identify risk factors and develop more effective prevention and treatment strategies. The exact figures of GERD prevalence estimates vary widely: 18.1%–27.8% in North America, 8.8%–25.9% in Europe, 2.5%–7.8% in East Asia, 8.7%–33.1% in the Middle East, 11.6% in Australia, and 23.0% in South America(5). Knowledge of the epidemiology of GERD can also support health decision-making at the public level and the targeting of medical resources in an efficient manner to provide adequate support to patients affected by this chronic disease. Recently published meta-analyses report an incidence rate of 13.98%, resulting in 1.3 billion people globally. The highest prevalence was observed in Saudi Arabia and was 45.4%, giving almost half the population (7). Additional factors linked to a higher risk of GERD included educational attainment, age, and the use of NSAIDs or aspirin (7).

Risk factors of gastroesophageal reflux disease

Smoking is known to weaken the function of the lower esophageal sphincter, thereby increasing the risk of reflux. Nicotine and other chemicals in cigarettes can also relax the aforementioned sphincter, allowing acid to back up into the esophagus more easily (8). Obesity is another major risk factor for GERD. Excess visceral fat can increase abdominal pressure and thus put pressure on the LES, favoring reflux (9). Lifestyle habits, such as lying down shortly after eating, can also promote reflux. Gravity helps to keep stomach acid in the stomach, so in a horizontal position acid can freely enter the esophagus. Additionally, pregnancy can contribute to GERD due to hormonal changes and increased abdominal pressure (10). Certain foods and drinks can exacerbate reflux symptoms. These include spicy or fatty foods, caffeine, alcohol, chocolate, citrus fruits, tomatoes, onions and garlic (11). Medications can also contribute to GERD, e.g. NSAIDs (non-steroidal anti-inflammatory drugs), calcium channel blockers, nitrates and some asthma medications can either relax the LES or irritate the esophagus, increasing the risk of reflux (12,13). Other factors, such as delayed gastric emptying (gastroparesis) often in diabetes, may contribute to GERD by allowing food and gastric acid to linger in the stomach longer, increasing the likelihood of reflux (14). Stress also contributes to symptoms.

Symptoms of gastroesophageal reflux disease

The symptoms of GERD are bothersome for several reasons, affecting various aspects of patients' health and daily life. Typical symptoms of reflux disease include heartburn, a burning sensation in the chest that often intensifies after eating or in recumbent position. These symptoms can be intense and chronic, leading to a constant feeling of discomfort, often worsen after meals or when lying down, making it difficult to function normally. Many people with GERD experience an increase in symptoms at night, leading to frequent waking, insomnia and an overall decrease in sleep quality . Patients may also experience regurgitation, where stomach acid backs up into the throat or mouth without vomiting reflex, causing a sour or bitter aftertaste (15–19). Atypical symptoms of reflux disease include a cough that is not a manifestation of pulmonary disease, laryngitis which may be caused by acid entering the vocal cords or worsening of asthma symptoms. Especially nocturnal episodes of reflux can also cause breathlessness and coughing. Globus sensation as a feeling of obstruction in the throat also can be mentioned, chronic sinus inflammation or infections can be exacerbated by reflux. Non-cardiac chest pain, which can mimic

heart pain, may be caused by reflux too (6,20–23). Interestingly, depression could slightly increase the risk of gastroesophageal reflux disease (24).

Impact of physical activity of GERD symptoms

Physical activity plays an important role in the management of GERD, but its impact can vary depending on the type and intensity of exercise performed and the individual predisposition of the patient. Regular exercise is beneficial as it can help maintain a healthy body weight or reduce excess weight, which is crucial as excess weight is one of the main risk factors for GERD (10). Lower body weight reduces pressure on the abdomen, which can reduce the risk of gastric contents backing up into the esophagus. Moderate-intensity exercise, such as walking, jogging, swimming or cycling, can promote digestion and speed up gastric emptying, which reduces the time food and stomach acids remain in the stomach. However, some high-intensity exercises, especially those involving the abdominal muscles (e.g. weight lifting, high-intensity running, jumping exercises), can increase intra-abdominal pressure, which can lead to increased reflux symptoms (25,26). In addition, some forms of exercise that require bending over or lying flat, such as certain yoga positions, can promote backflow of gastric contents into the esophagus, which can provoke reflux symptoms (27,28). Another study reports that excessive physical activity is a significant risk factor for developing GERD, regular and mild to moderate physical activity is associated with less frequent reflux symptoms (29).

Treatment strategies

The main goal of therapy is to relieve symptoms; in mild to moderate cases, lifestyle modification is often recommended, including dietary changes (avoiding spicy, fatty and acidic foods), avoiding meals just before bedtime, elevating the headboard of the bed while sleeping, and limiting alcohol and nicotine intake. Pharmacotherapy usually includes drugs that reduce gastric acid secretion, such as proton pump inhibitors (PPIs) or H2-receptor blockers (2,6,30,31). These drugs are designed to reduce the amount of acid in the stomach, which can reduce the severity of reflux symptoms. In the case of a first-ever episode of reflux disease in a patient before the age of 40 with no alarm symptoms, treatment should be initiated without further diagnosis with a PPI at the standard dose. If therapy is ineffective, the standard dose can be doubled, only if this too does not help should endoscopic diagnostics be performed (32). Another strategy to address symptomatic GERD involves obstructing the passage of acidic refluxate. Alginic acid derivatives, known as alginates, manage GERD through a distinct mechanism: they create a physical barrier that displaces the postprandial acid pocket (33). In more severe cases, or when symptoms cannot be effectively controlled with medication, surgical procedures such as fundoplication, which involves wrapping the upper part of the stomach around the lower part of the esophagus to strengthen the anti-reflux barrier, may be necessary (34). Tests that can help qualify a patient for such a procedure are pH-metry with impedance and high-resolution esophageal manometry.

Conclusion

In conclusion, GERD is a prevalent chronic condition that significantly impacts patients' quality of life and presents challenges in both diagnosis and management. Understanding its pathophysiology involving lower esophageal sphincter dysfunction, impaired esophageal clearance, and other contributing factors like hiatal hernia and delayed gastric emptying is crucial. Epidemiological insights underscore its global prevalence and varying regional trends, highlighting the need for tailored prevention and treatment strategies. Effective management of GERD involves a

multifaceted approach encompassing lifestyle modifications, pharmacotherapy, and in some cases, surgical intervention. Lifestyle adjustments such as dietary changes, maintaining a healthy weight, and optimizing physical activity can play a pivotal role in symptom management. Pharmacological options PPIs remain cornerstone treatments for reducing gastric acid secretion, alleviating symptoms, and preventing complications. For refractory cases or those with severe complications, surgical interventions like fundoplication offer a viable solution. However, the decision for surgical intervention should be guided by thorough evaluation using diagnostic tools such as pH-metry and high-resolution esophageal manometry . In conclusion, while GERD poses significant challenges, advancements in understanding its mechanisms and effective treatment options provide hope for improved outcomes and enhanced quality of life for patients worldwide. Continued research into its pathophysiology and epidemiology will further refine our approaches to prevention, diagnosis, and treatment, benefiting those affected by this pervasive condition.

Authors contribution

For full transparency, all submitted manuscripts must include an Author Contribution Statement stating the work of each author. For research articles with multiple authors, a short paragraph must be provided stating their individual contributions.

The following statements should be used:

Conceptualization: Justyna Puchała, Adam Salwa

Methodology: Natalia Gajdzińska, Justyna Puchała

Software: Maciej Rzepka, Wojciech Rutkowski, Justyna Puchała

Check: Natalia Gajdzińska, Adam Salwa, Justyna Puchała

Formal Analysis: Adam Salwa, Justyna Puchała

Investigation: Weronika Rostkowska, Natalia Gajdzińska, Wojciech Rutkowski

Resources: Dominika Starzomska, Justyna Puchała, Katarzyna Rymaszewska

Data curation: Natalia Gajdzińska, Maciej Rzepka

Writing- rough preparation: Justyna Puchała Adam Salwa,

Writing- review and editing:, Karolina Sztuba

Visualization: Adam Salwa, Weronika Rostkowska

Supervision: Karolina Sztuba, Dominika Starzomska

Project administration: Natalia Gajdzińska

Receiving fundings: no fundings was received.

All authors have read and agreed with the published version of manuscript.

Funding statement: No financial support was received.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Our work did not involve direct human subject research or obtaining their consent for participation in the study.

Data Availability Statement: Since this is a review paper, our work does not contain new data or analyses. Consequently, there are no databases or data accessibility to outline. The details and conclusions presented in this review are derived from previously published studies, which can be accessed through their respective sources as mentioned in the references section.

Conflict of interest: The authors declare no conflict of interest.

References

1. Shaqran TM, Ismaeel MM, Alnuaman AA, Al Ahmad FA, Albalawi GA, Almubarak JN, et al. Epidemiology, Causes, and Management of Gastro-esophageal Reflux Disease: A Systematic Review. Cureus [Internet]. 2023 Oct 21; Available from: https://www.cureus.com/articles/191968-epidemiology-causes-and-management-of-gastro-esophageal-reflux-disease-a-systematic-review
2. Fass R. Erosive Esophagitis and Nonerosive Reflux Disease (NERD). J Clin Gastroenterol [Internet]. 2007 Feb;41(2):131–7. Available from: https://journals.lww.com/00004836-200702000-00004
3. Tran CL, Han M, Kim B, Park EY, Kim Y Il, Oh J. Gastroesophageal reflux disease and risk of cancer: Findings from the Korean National Health Screening Cohort. Cancer Med [Internet]. 2023 Sep 7;12(18):19163–73. Available from: https://onlinelibrary.wiley.com/doi/10.1002/cam4.6500
4. Katz PO, Gerson LB, Vela MF. Guidelines for the Diagnosis and Management of Gastroesophageal Reflux Disease. Am J Gastroenterol [Internet]. 2013 Mar;108(3):308–28. Available from: https://journals.lww.com/00000434-201303000-00006
5. El-Serag HB, Sweet S, Winchester CC, Dent J. Update on the epidemiology of gastro-oesophageal reflux disease: a systematic review. Gut [Internet]. 2014 Jun;63(6):871–80. Available from: https://gut.bmj.com/lookup/doi/10.1136/gutjnl-2012-304269
6. Vakil N, van Zanten S V., Kahrilas P, Dent J, Jones R. The Montreal Definition and Classification of Gastroesophageal Reflux Disease: A Global Evidence-Based Consensus. Am J Gastroenterol [Internet]. 2006 Aug;101(8):1900–20. Available from: http://www.nature.com/doifinder/10.1111/j.1572-0241.2006.00630.x
7. Nirwan JS, Hasan SS, Babar Z-U-D, Conway BR, Ghori MU. Global Prevalence and Risk Factors of Gastro-oesophageal Reflux Disease (GORD): Systematic Review with Meta-analysis. Sci Rep [Internet]. 2020 Apr 2;10(1):5814. Available from: https://www.nature.com/articles/s41598-020-62795-1
8. Kulig M, Nocon M, Vieth M, Leodolter A, Jaspersen D, Labenz J, et al. Risk factors of gastroesophageal reflux disease: methodology and first epidemiological results of the ProGERD study. J Clin Epidemiol [Internet]. 2004 Jun;57(6):580–9. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0895435603004256
9. Eslick GD, Talley NJ. Gastroesophageal Reflux Disease (GERD). J Clin Gastroenterol [Internet]. 2009 Feb;43(2):111–7. Available from: https://journals.lww.com/00004836-200902000-00003
10. Djärv T. Physical activity, obesity and gastroesophageal reflux disease in the general population. World J Gastroenterol [Internet]. 2012;18(28):3710. Available from: http://www.wjgnet.com/1007-9327/full/v18/i28/3710.htm
11. Jarosz M, Taraszewska A. Risk factors for gastroesophageal reflux disease – the role of diet. Gastroenterol Rev [Internet]. 2014;5:297–301. Available from: http://www.termedia.pl/doi/10.5114/pg.2014.46166
12. Argyrou A, Legaki E, Koutserimpas C, Gazouli M, Papaconstantinou I, Gkiokas G, et al. Risk factors for gastroesophageal reflux disease and analysis of genetic contributors. World J Clin Cases [Internet]. 2018 Aug 16;6(8):176–82. Available from: http://www.wjgnet.com/2307-8960/full/v6/i8/176.htm
13. Yadlapati R, Gyawali CP, Pandolfino JE, Chang K, Kahrilas PJ, Katz PO, et al. AGA Clinical Practice

Update on the Personalized Approach to the Evaluation and Management of GERD: Expert Review. Clin Gastroenterol Hepatol [Internet]. 2022 May;20(5):984-994.e1. Available from: https://linkinghub.elsevier.com/retrieve/pii/S1542356522000799

14. Jehangir A, Parkman HP. Reflux Symptoms in Gastroparesis. J Clin Gastroenterol [Internet]. 2020 May;54(5):428–38. Available from: https://journals.lww.com/10.1097/MCG.0000000000001190
15. Li Q, Duan H, Wang Q, Dong P, Zhou X, Sun K, et al. Analyzing the correlation between gastroesophageal reflux disease and anxiety and depression based on ordered logistic regression. Sci Rep [Internet]. 2024 Mar 19;14(1):6594. Available from: https://www.nature.com/articles/s41598-024-57101-2
16. Aziz Q, Fass R, Gyawali CP, Miwa H, Pandolfino JE, Zerbib F. Esophageal disorders. Gastroenterology. 2016;150(6):1368–79.
17. Lundell LR, Dent J, Bennett JR, Blum AL, Armstrong D, Galmiche JP, et al. Endoscopic assessment of oesophagitis: Clinical and functional correlates and further validation of the Los Angeles classification. Gut. 1999;45(2):172–80.
18. Badillo R. Diagnosis and treatment of gastroesophageal reflux disease. World J Gastrointest Pharmacol Ther [Internet]. 2014;5(3):105. Available from: http://www.wjgnet.com/2150-5349/full/v5/i3.105.htm
19. Davis TA, Gyawali CP. Refractory Gastroesophageal Reflux Disease: Diagnosis and Management. J Neurogastroenterol Motil [Internet]. 2024 Jan 30;30(1):17–28. Available from: http://www.jnmjournal.org/journal/view.html?doi=10.5056/jnm23145
20. Mainie I. Acid and non-acid reflux in patients with persistent symptoms despite acid suppressive therapy: a multicentre study using combined ambulatory impedance-pH monitoring. Gut [Internet]. 2006 Oct 1;55(10):1398–402. Available from: https://gut.bmj.com/lookup/doi/10.1136/gut.2005.087668
21. Hall JF, Stein SL. Unexpected Intra-operative Findings. Surg Clin North Am [Internet]. 2013 Feb;93(1):45–59. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0039610912002010
22. Ford AC, Forman D, Bailey AG, Axon ATR, Moayyedi P. The natural history of gastro-oesophageal reflux symptoms in the community and its effects on survival: a longitudinal 10-year follow-up study. Aliment Pharmacol Ther [Internet]. 2013 Feb;37(3):323–31. Available from: https://onlinelibrary.wiley.com/doi/10.1111/apt.12169
23. Oh TH. Atypical Manifestation of Gastroesophageal Reflux Disease: A Disease With a Thousand Faces. J Neurogastroenterol Motil [Internet]. 2014 Jan 31;20(1):1–3. Available from: http://www.jnmjournal.org/journal/view.html?doi=10.5056/jnm.2014.20.1.1
24. Chen G, Xie J, Ye J, Kuang X, Liao W, Song L, et al. Depression Promotes Gastroesophageal Reflux Disease: New Evidence Based on Mendelian Randomization. Turkish J Gastroenterol [Internet]. 2023 Feb 15; Available from: https://turkjgastroenterol.org/en/depression-promotes-gastroesophageal-reflux-disease-new-evidence-based-on-mendelian-randomization-137019
25. Jozkow P, Wasko-Czopnik D, Medras M, Paradowski L. Gastroesophageal Reflux Disease and Physical Activity. Sport Med [Internet]. 2006;36(5):385–91. Available from: http://link.springer.com/10.2165/00007256-200636050-00002
26. Festi D, Scaioli E, Baldi F, Vestito A, Pasqui F, Biase AR Di, et al. Body weight, lifestyle, dietary habits and gastroesophageal reflux disease. World J Gastroenterol [Internet]. 2009;15(14):1690. Available from: http://www.wjgnet.com/1007-9327/full/v15/i14/1690.htm

27. Lam S, Hart AR. Does physical activity protect against the development of gastroesophageal reflux disease, Barrett's esophagus, and esophageal adenocarcinoma? A review of the literature with a meta-analysis. Dis Esophagus [Internet]. 2017 Nov 1;30(11):1–10. Available from: http://academic.oup.com/dote/article/30/11/1/4096690/Does-physical-activity-protect-against-the
28. Taraszewska A. Risk factors for gastroesophageal reflux disease symptoms related to lifestyle and diet. Rocz Państwowego Zakładu Hig [Internet]. 2021; Available from: http://wydawnictwa.pzh.gov.pl/roczniki_pzh/pobierz-artykul?id=1367
29. Dagli U, Kalkan IH. The role of lifestyle changes in gastroesophageal reflux diseases treatment. Turkish J Gastroenterol [Internet]. 2020 Apr 5;28(Supp1):S33–7. Available from: https://turkjgastroenterol.org/en/the-role-of-lifestyle-changes-in-gastroesophageal-reflux-diseases-treatment-135188
30. Pace F, Porro GB. On-demand PPI therapy in GERD. Curr Treat Options Gastroenterol [Internet]. 2008 Feb;11(1):35–42. Available from: http://link.springer.com/10.1007/s11938-008-0005-y
31. Gyawali CP, Fass R. Management of Gastroesophageal Reflux Disease. Gastroenterology [Internet]. 2018 Jan;154(2):302–18. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0016508517359899
32. Slater BJ, Dirks RC, McKinley SK, Ansari MT, Kohn GP, Thosani N, et al. SAGES guidelines for the surgical treatment of gastroesophageal reflux (GERD). Surg Endosc [Internet]. 2021 Sep 19;35(9):4903–17. Available from: https://link.springer.com/10.1007/s00464-021-08625-5
33. Leiman DA, Riff BP, Morgan S, Metz DC, Falk GW, French B, et al. Alginate therapy is effective treatment for GERD symptoms: a systematic review and meta-analysis. Dis Esophagus [Internet]. 2017 May 1;30(5):1–9. Available from: https://academic.oup.com/dote/article/30/5/1/3092443
34. McKinley SK, Dirks RC, Walsh D, Hollands C, Arthur LE, Rodriguez N, et al. Surgical treatment of GERD: systematic review and meta-analysis. Surg Endosc [Internet]. 2021 Aug 2;35(8):4095–123. Available from: https://link.springer.com/10.1007/s00464-021-08358-5