



Published in final edited form as:

Clin Gastroenterol Hepatol. 2016 February ; 14(2): 175–182.e3. doi:10.1016/j.cgh.2015.04.176.

Lifestyle intervention in gastroesophageal reflux disease

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Abstract

Background & Aims—Gastroesophageal reflux disease (GERD) affects up to 30% of adults in Western populations and is increasing in prevalence. GERD is associated with lifestyle factors, particularly obesity and tobacco smoking, which also threatens the general health. GERD carries risk of several adverse outcomes and there is widespread use of potent acid-inhibitors which are associated with long-term adverse effects. The aim of this systematic review was to assess the role of lifestyle intervention in the treatment of GERD.

Methods—Literature searches were performed in PubMed (from 1946), EMBASE (from 1980), and the Cochrane Library (no start date) to October 1, 2014. Meta-analyses, systematic reviews, randomized clinical trials (RCTs) and prospective observational studies were included.

Results—Weight loss was followed by decreased time with esophageal acid exposure in two RCTs (from 5.6% to 3.7% and from 8.0% to 5.5%, respectively), and reduced reflux symptoms in prospective observational studies. Tobacco smoking cessation reduced reflux symptoms in normal weight individuals in a large prospective cohort study (odds ratio 5.67). In RCTs, late evening meals increased time with supine acid exposure compared to early meals (5.2% points change),

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Disclosures: No relevant conflicts of interest exist

Author contributions: ENJ was involved in study concept and design, acquisition and interpretation of literature, drafting of the manuscript, and critical revision of the manuscript for important intellectual content. HES was involved in study concept and design, acquisition and interpretation of literature, and critical revision of the manuscript for important intellectual content. KH and JL were involved in study concept and design, interpretation of literature, and critical revision of the manuscript for important intellectual content.

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and head of the bed elevation decreased time with supine acid exposure compared to a flat position (from 21% to 15%).

Conclusions—Weight loss and tobacco smoking cessation should be recommended to GERD patients who are obese and smoke, respectively. Avoiding late evening meals and head of the bed elevation is effective in nocturnal GERD.

Keywords

GERD; heartburn; acid regurgitation; therapy; treatment

Gastroesophageal reflux disease (GERD), defined by at least weekly symptoms of heartburn or acid regurgitation, is increasingly common.¹ The prevalence in adults ranges from 30% in some Western populations to below 10% in East Asian populations, and the incidence is about 5/1000 person-years in Western populations.¹ GERD is associated with reduced health-related quality of life,² decreased work productivity³ and increased risk of esophageal adenocarcinoma.⁴ The annual incidence of esophageal adenocarcinoma is increasing worldwide, from 3.5% in Scotland to 8.1% in Hawaii, which parallels the increasing prevalence of GERD.⁵ In addition, GERD diagnostic tests and treatments carry high societal costs.⁶

The pathophysiology of GERD is dominated by functional and anatomic defects at the gastroesophageal junction, including reduced pressure and increased reflux episodes associated with transient relaxations of the lower esophageal sphincter and formation of hiatal hernia which promotes and facilitates reflux.^{7–9} Esophageal motility and salivary bicarbonate contribute to esophageal acid clearance and buffering, respectively, and reduce acid contact time in the esophagus.^{10,11} Visceral obesity increases the pressure over the gastroesophageal junction, thus facilitating reflux,¹² while tobacco smoking reduces the lower esophageal sphincter pressure and salivary bicarbonate secretion, which facilitates reflux and decreases acid buffering, respectively.^{13,14}

The main established risk factors of GERD are heredity, obesity and tobacco smoking.^{15–18} High dietary fiber intake and moderate physical exercise seem to reduce this risk,¹⁸ while sex and age do not strongly influence the risk of GERD.^{19,20} Obesity is of particular interest since it is increasing in prevalence in parallel with GERD, and several studies have shown an increased risk of GERD and esophagitis with obesity, especially abdominal obesity.^{21,22}

GERD is typically diagnosed by the cardinal symptoms heartburn or acid regurgitation²³ and symptom resolution following acid-inhibition with a proton pump inhibitor (PPI).²⁴ If symptoms do not resolve, endoscopy is usually performed and mucosal erosions (esophagitis) or peptic strictures are diagnostic of GERD.²⁵ Endoscopy can also reveal Barrett's esophagus, a premalignant columnar metaplasia, and esophageal adenocarcinoma. If endoscopy is normal, esophageal pH-measurement can still reveal pathologic acid reflux (pH <4).²⁶ The pH-measurement can be combined with impedance-measurement to detect reflux of weakly acidic or non-acidic liquid and gas, which can cause reflux symptoms refractory to acid inhibition.²⁷

The treatment of GERD is primarily by medication with antacids, H₂-receptor antagonists and PPIs, while surgery (typically with fundoplication) is used in selected patients. Recent evidence shows that long-term PPI medication is hampered by adverse effects. This includes secondary hypergastrinemia and rebound acid hypersecretion, inducing reflux symptoms at withdrawal of PPI medication;²⁸ increased risk of enteric infections and community acquired pneumonia, probably due to increased gastric pH causing reduced host defence;^{29,30} and increased risk of hip and vertebral fractures, probably due to malabsorption of calcium.³¹

This review addresses lifestyle intervention in the treatment of GERD and compares existing evidence with current guidelines.

METHODS

Systematic literature searches on lifestyle intervention in GERD were performed in MEDLINE using PubMed from 1946 and EMBASE using OvidSP from 1980 to October 1, 2014. In addition, the Cochrane Library was searched, last time October 1, 2014. The searches included thesaurus terms (MeSH in MEDLINE and Emtree in EMBASE): “gastroesophageal reflux”, “heartburn”, “peptic esophagitis” (EMBASE)/“esophagitis, peptic” (MEDLINE) and “non-erosive reflux disease” (EMBASE). Randomized clinical trials (RCTs), prospective observational studies, and meta-analyses and systematic reviews of RCTs or observational studies of GERD patients were included. The searches were limited to the English language and research on adult humans. The evidence of interventions was graded using the American Heart Association’s guidelines: Multiple populations evaluated, data derived from multiple RCTs or meta-analyses (**Level A**); limited populations evaluated, data derived from a single RCT or non-randomized studies (**Level B**); and very limited populations evaluated, only consensus opinion of experts, case studies or standard of care (**Level C**).

RESULTS

Literature searches

Literature searches on lifestyle intervention identified 15 original studies that met the inclusion criteria (Table and eTable). In addition, one previous systematic review on lifestyle intervention and one previous systematic review on conservative and surgical treatment for obesity in GERD were identified.^{32,33} No relevant Cochrane reviews were identified. Three management guidelines were assessed: the Canadian Association of Gastroenterology (CAG) consensus (2005);²⁴ the American Gastroenterological Association (AGA) medical position statement and technical review (2008);^{34,35} and the American College of Gastroenterology (ACG) guideline (2013).³⁶

Lifestyle interventions

Lifestyle interventions in GERD have traditionally included avoidance of foods that may precipitate reflux episodes and heartburn (e.g., coffee, alcohol, chocolate, peppermint, citrus, carbonated drinks and spicy foods) and behavioral changes with weight loss, smoking cessation, head of the bed elevation, avoiding large meals and avoiding recumbence after

meals or meals before bedtime.^{34,35} The previous systematic review on lifestyle intervention in GERD concluded that only weight loss and head of the bed elevation were effective for GERD, while the systematic review on conservative and surgical treatment for obesity concluded that dietary and lifestyle intervention may improve GERD in obese patients.^{32,33} However, new supportive evidence has emerged.

Weight loss—Three RCTs in severely obese individuals compared weight loss by gastric balloon distension with sham treatment combined with dietary guidance, physical exercise and behavioral therapy, and showed reduced esophageal acid exposure with weight loss.^{37–39} In the first RCT, including 17 patients, 3 of 5 patients with pathological pH-measurements got normalized pH-measurements with weight loss of 31.3–44.0 kg after 4 months.³⁷ In the second RCT, 23 patients with a mean weight loss of 11.2 kg within 13 weeks had decreased time with esophageal pH <4 (from 5.60% to 3.72%, $P < 0.05$).³⁸ Moreover, there was a strong correlation between decreased waist circumference and acidic reflux time ($r=0.78$, $P=0.000$).³⁸ These results were supported by the third RCT of 17 sham treated patients, where mean weight loss of 12.5 kg within 13 weeks improved time with upright pH <4 (from 8.0% to 5.5%, $P < 0.05$).³⁹

A larger RCT compared obese participants randomized to a structured weight loss program ($n=167$) or a telephone-based group conference on weight management ($n=165$). The prevalence of reflux symptoms decreased (from 37% to 15%, $P < 0.01$) and the symptom score improved (Reflux Disease Questionnaire, $P < 0.01$) after 6 months of weight loss (mean body mass index (BMI) decreased from 34.7 to 30.2), irrespective of treatment group.⁴⁰

These results were confirmed in 2 uncontrolled prospective cohort studies of GERD patients.^{41,42} A study of 8 extremely obese patients (mean BMI 43.5) showed significant improved total time with pH <4 (from 5.1% to 2.5%, $P=0.022$) and reflux symptoms score (Distress Subscale of Gastroesophageal Reflux Disease Symptom Assessment Scale from 1.28 to 0.72, $P=0.0004$) after 4 days on a very low-carbohydrate diet and a mean weight loss of 1.7 kg.⁴¹ Moreover, a study of 34 patients with mean BMI of only 23.5, reflux symptoms and either normal endoscopy or low grade esophagitis also showed significant correlation between weight loss after dietary advice (mean BMI decrease 1.7) and reflux symptom score (modified DeMeester questionnaire, $r=0.548$, $P < 0.001$).⁴²

Two large prospective population-based cohort studies showed that weight reduction dose-dependently decreased reflux symptoms.^{43,44} The Nurses' Health Study, an observational cohort study of 10,545 women, showed a dose-dependently reduced risk of reflux symptoms among women who had decrease in BMI compared to women with no BMI change (odds ratio (OR) 0.64, 95% confidence interval (CI) 0.42–0.97 with >3.5 units decrease in BMI, P for trend <0.001).⁴³ The HUNT study, a prospective population-based cohort study of 29,610 participants also showed a dose-dependent association between weight loss and the chance of losing reflux symptoms (OR 2.42, 95% CI 1.88–3.11 with >3.5 units decrease in BMI, P for trend <0.001). In this study, decrease in BMI was also associated with an increased chance of losing reflux symptoms with medical treatment (OR 1.98, 95% CI 1.45–2.72 with >3.5 units decrease in BMI and no or less than weekly medication compared to

OR 3.96, 95% CI 2.03–7.65 with >3.5 units decrease in BMI and at least weekly medication).⁴⁴

Challenging these results, a small RCT showed that weight loss (mean 10.8 kg) did not have significant effects on symptoms, esophagitis or pH-measurements in obese patients (mean BMI=31.4) with GERD who were randomized to a low-caloric diet (430 kcal/day) for 6 months (n=10) or not (n=9).⁴⁵ In addition, a prospective population-based cohort study of 637 individuals showed no association between weight loss and reflux symptoms, but since weight loss was self-reported it might be overestimated.⁴⁶

Tobacco smoking cessation—A prospective population-based cohort study (the HUNT study) of 29,610 participants showed that smoking cessation was associated with decreased severe reflux symptoms in normal weight individuals on medical treatment, compared to participants who continued smoking daily (OR 5.67, 95% CI 1.36–23.64).⁴⁷ However, there was no similar association in overweight (BMI 25.0–29.9) or 9 obese (BMI 30.0) individuals (OR 1.24, 95% CI 0.57–2.71 and OR 1.29, 95% CI 0.53–3.17, respectively). A possible explanation for these findings is that GERD pathophysiology in obese individuals is strongly dictated by weight, while smoking plays a minor role, but smoking is a more important factor in non-obese individuals.

Dietary interventions—A RCT showed no influence of weight loss following a 6 month period of low-caloric diet (430 kcal/day) on GERD.⁴⁵ However, a small non-randomized study of 8 severely obese patients (mean BMI=43.5) who lost weight (1.7 kg) on a 4-day very low-carbohydrate diet (<20g/day) showed a decreased total time with pH <4 (from 5.1% to 2.5%, $P=0.022$) and reflux symptoms score (from 1.28 to 0.72, $P=0.0004$).⁴¹

A crossover RCT of 30 patients randomized to a late meal (2 hours before bedtime) or an early meal (6 hours before bedtime) showed more pH-verified supine reflux after the late evening meal (mean change 5.2%, $P=0.002$).⁴⁸

A RCT that compared patients using a dietary fiber product (n=15) with placebo (n=15) for 2 weeks, showed an increased number of days without heartburn (mean 1.87 and 0.73, respectively, $P<0.05$) and reduced severity score (mean 7.7 and 13.3, respectively, $P<0.05$) in the fiber group.⁴⁹

A systematic review based on observational studies showed no evidence of carbonated beverages promoting GERD.⁵⁰

Regarding other potential dietary interventions there were no studies meeting the search criteria.

Head of bed elevation—A crossover RCT of 15 GERD participants, showed that elevation of the head of the bed by a 10 inch wedge decreased esophageal pH <4 time compared to a flat position (15% and 21%, respectively, $P<0.05$).⁵¹

DISCUSSION

RCTs have shown reduced reflux symptoms and esophageal acid exposure with weight loss,^{37–40} findings supported by well-designed observational studies showing a dose-dependent decreased presence of reflux symptoms following weight reduction. A large prospective observational study showed reduced reflux symptoms with tobacco smoking cessation in normal weight individuals.⁴⁷ RCTs also showed that early evening meals⁴⁸ and head of the bed elevation⁵¹ decreased the esophageal acid exposure time, and dietary fiber decreased reflux symptoms.⁴⁹

Based on the present review, we believe that the evidence of lifestyle modifications in GERD has been strengthened compared to the statements in the three current treatment guidelines.^{24,34–36} The CAG guideline concludes that lifestyle modifications are ineffective for frequent or severe reflux symptoms and that data are insufficient to support lifestyle modifications in mild reflux.²⁴ The AGA guideline recommends weight loss in obese GERD patients and elevation of the head of the bed in patients experiencing reflux symptoms when recumbent, while other lifestyle modifications should be individually tailored.^{34,35} The ACG guideline supports avoidance of meals two to three hours before bedtime, in addition to weight loss and head of bed elevation. However, it does not recommend elimination of food that can trigger reflux.³⁶

We believe that patients suffering from GERD should be recommended to lose weight if they are obese, that tobacco smoking cessation and increased dietary fiber should be encouraged and that late evening meals should be avoided and head of the bed elevation recommended for patients with supine reflux. Based on the pathophysiologic mechanisms, weight loss in obese patients will presumably reduce the increased pressure on the gastroesophageal junction, reducing reflux.¹² Smoking cessation will normalize the lower esophageal sphincter pressure and salivary bicarbonate production.^{13,14} It is speculated that dietary fiber expand with water to form a barrier to the acid rising into the esophagus.⁴⁹ Avoiding late evening meals and head of the bed elevation will reduce nighttime supine reflux.^{48,51} Any effect of a very low-carbohydrate diet is uncertain, as the study included cannot separate the effects of weight loss from those of the diet.⁴¹ However, a small case series showed a significant and almost immediate resolution of GERD symptoms in obese individuals initiating a very low-carbohydrate diet.⁵² Lifestyle interventions, especially weight loss and tobacco smoking cessation, are also beneficial from other perspectives, including low economic costs, no harmful side-effects and overall health benefits. In addition, observational studies have shown that weight loss and tobacco smoking cessation are associated with improved success with medical treatment.^{44,47}

Extensive data exists on the effects of acid inhibiting medication in GERD, opposed to only few and heterogeneous RCTs or observational studies of lifestyle intervention. Commercial interests are probably the main reason for this imbalance of studies. Non-commercial funding should focus on performing larger RCTs on lifestyle interventions to verify these results and get more reliable conclusion. Nevertheless, the available evidence is reasonably consistent and supported by the pathophysiology and epidemiology. The effects of these interventions on reflux symptoms, acid exposure and endoscopic findings should be

assessed in future studies. As obesity and smoking are risk factors of GERD, reduced prevalence of these exposures in the populations could also reduce the incidence of GERD.

CONCLUSIONS

Recent evidence supports lifestyle intervention in the treatment of GERD. These include weight loss, tobacco smoking cessation, avoiding late evening meals, and head of the bed elevation. Meanwhile, the awareness of adverse effects of medical treatment has increased, questioning long-term and continuous PPI therapy, at least in mild GERD.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Grant support: ENJ is supported by the Norwegian and Swedish Research Councils. KH has no grant support covering his wages. HES is supported by NIH K24 DK04-107 and the Houston VA Health Services Research and Development Center of Excellence (HFP90-020). JL is supported by grants from the Swedish Research Council.

Abbreviations (alphabetically)

| | |
|-------------|--|
| ACG | American College of Gastroenterology |
| AGA | American Gastroenterological Association |
| BMI | body mass index |
| CAG | Canadian Association of Gastroenterology |
| CI | confidence interval |
| GERD | gastroesophageal reflux disease |
| HUNT | The Nord-Trøndelag health study |
| OR | odds ratio |
| PPI | proton pump inhibitor |
| RCT | randomized clinical trial |

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Table

Lifestyle intervention in gastroesophageal reflux disease (GERD)

| Category | Study | Design | Intervention | Findings | Level of evidence ^a | Caution ^b | Caution ^c | Caution ^d |
|---------------------------|---|--|---------------------------------------|--|--------------------------------|----------------------|----------------------|----------------------|
| Weight loss | Mitchell-Vogien et al. 2006 ²⁶ | RCT ¹ | Gastric balloon vs sham treatment | No effect on symptoms, endoscopic findings or acid exposure in 3 of 5 with weight loss | A | | | |
| | Mitchell-Vogien et al. 2007 ²⁷ | RCT ¹ | Gastric balloons vs sham treatment | Reduced acid exposure in 3 of 5 with weight loss | A | | | |
| Dietary interventions | Mitchell-Vogien et al. 2003 ²⁸ | RCT ¹ | Gastric balloons vs sham treatment | Reduced acid exposure in 3 of 5 with weight loss | A | | | |
| | Stoll et al. 2012 ²⁹ | RCT ¹ | Decreased weight vs sham treatment | Decreased symptom score in both groups | A | | | |
| Head of the bed elevation | Austin et al. 2004 ³⁰ | Non-randomized prospective study | Very low-carbohydrate diet | Decreased acid exposure and symptom score | B | | | |
| | Franzblau et al. 2007 ³¹ | Non-randomized prospective study | Dietary advice | Decreased symptom score | B | | | |
| Tobacco smoking cessation | Ness-Jensen et al. 2014 ³² | Prospective cohort study | No intervention | Dose-dependent decrease in symptoms, improved acid exposure | B | | | |
| | Ness-Jensen et al. 2013 ³³ | Prospective cohort study | No intervention | Dose-dependent decrease in symptoms, improved acid exposure | B | | | |
| Dietary interventions | Kjellin et al. 1996 ³⁴ | RCT ¹ | Low-calorie diet vs control | No effect on symptoms, endoscopic findings or acid exposure | B | | | |
| | Costantino et al. 2004 ³⁵ | Prospective cohort study | No intervention | No association with symptoms | B | | | |
| Head of the bed elevation | Kjellin et al. 2006 ³⁶ | RCT ¹ | Non-caloric diet vs control | Decreased symptoms in normal weight individuals | B | | | |
| | Austin et al. 2006 ³⁷ | Non-randomized prospective study | Very low-carbohydrate diet | Decreased acid exposure and symptom score | B | | | |
| Dietary interventions | Prohman et al. 2007 ³⁸ | RCT ¹ | Lact vs early evening meal | Decreased acid exposure with early evening meal | B | | | |
| | Dalwadi et al. 2011 ³⁹ | RCT ¹ | Dietary fiber vs placebo | Decreased symptom score and acid score with dietary fiber | B | | | |
| Head of the bed elevation | Johnson et al. 2003 ⁴⁰ | Systematic review of observational studies | Carbonated beverages | No effect on GERD | B (no effect) | | | |
| | Hammaker et al. 2002 ⁴¹ | RCT ¹ | Head of bed elevation vs no elevation | Decreased acid exposure with head of bed elevation | B | | | |

^a A - Multiple populations evaluated, data derived from multiple randomized clinical trials or meta-analyses; B - Limited populations evaluated, data derived from a single randomized clinical trial or non-randomized studies; C - Very limited populations evaluated, only consensus opinion of experts, case studies, or standard of care.

^b Canadian Association of Gastroenterology.

^c American Gastroenterological Association.

^d American College of Gastroenterology.

^e Randomized clinical trial.