Peer reviewed article

The relationship between gastroesophageal reflux disease and the level of physical activity

Paweł Jóźków[a], *Dorota Waśko-Czopnik*[b], *Katarzyna Dunajska*[a], *Marek Mędraś*[a], *Leszek Paradowski*[b]

[a] Department of Sports Medicine, University School of Physical Education, Wroclaw, Poland
[b] Department. of Gastroenterology & Hepatology, Wroclaw Medical University, Wroclaw, Poland

Summary

Principles: Data on associations between physical activity and gastroesophageal reflux disease (GERD) have been inconsistent. Although experimental and clinical studies prove that exercise increases gastroesophageal reflux, epidemiological observations on the relationship between GERD and everyday physical effort deliver contradictory results.

Our aim was to examine the association between the level of everyday physical activity and parameters of the disease (pH-metry, symptoms) in patients diagnosed with GERD.

Methods: We assessed the level of physical activity in a survey of 100 consecutive GERD patients. All subjects had undergone 24-h pH monitoring in a tertiary setting and reported symptoms they experienced daily. Using the criteria of the short form of the International Physical Activity Questionnaire (7-day recall) we identified groups presenting with low (I), moderate (II) or high (III) levels of physical activity. The amount of physical activity was expressed as multiples of resting metabolic rate and minutes of performance during a week (METs-minute/week). For evaluation of relationships between everyday physical activity and pH-metric indices of GERD a multivariate regression analysis was performed. The parameters studied were adjusted for age, BMI, smoking and gender (as covariates).

Results: We did not observe any association between the amount of everyday physical activity (expressed as log base 10 METs-minute/week) and pH-metric parameters of GERD evaluated 5 cm and 15 cm above the lower oesophageal sphincter (LES). Furthermore, we analyzed relationships between investigated parameters and covariates: age, BMI, smoking and gender. We found significant correlations only between the number of reflux episodes 15 cm above LES and gender (beta –0.25; $p < 0.05$) and between the number of reflux episodes 5 cm above LES and age (beta –0.24; $p < 0.05$).

The number of self-reported symptoms did not differ among the three groups of physical activity level. It reached 6 in groups I and II, and 7 in group III ($p = 0.07$). However we must note that we found a weak, positive correlation between the number of symptoms reported by patients and METs-minute/week ($r = 0.21$, $p < 0.05$).

Conclusions: In view of our results the level of everyday physical activity is not associated with symptoms of GERD. This observation should be confirmed in other populations with GERD diagnosed upon pH-metric criteria.

Key words: gastroesophageal reflux disease; gerd; motor activity; humans

Introduction

Epidemiological studies show that symptoms of gastroesophageal reflux disease (GERD) occur monthly in 13% Japanese [1], 21–29% Finish [2] and up to 31% Norwegians [3]. Typical ailments are reported weekly by 5% of Japanese subjects [1], 10% of French people [4], 15% in a Finish population [2] and in about 20% of Americans [5].

At the same time it has been suggested that GERD decreases the quality of life comparable to conditions such as ischaemic heart disease, mild heart failure, diabetes or back pain [6–8].

Although the aetiology of GERD has not been fully elucidated, the role of exogenous components seems to be crucial in the development of the disease [9]. One of these components is physical activity. It has been well documented that strenuous exercise exacerbates symptoms of GERD [10–12]. Interestingly, the relationship be-

Grant support: University School of Physical Education, Wroclaw, Poland.

tween the level of everyday physical activity and GERD has not yet been established. In previous surveys the association between physical activity and symptoms compatible with GERD were: positive [13], negative [3] or not existent [14].

Our aim was to evaluate associations between parameters of the disease (pH-metry, symptoms) and the level of everyday physical activity in patients with diagnosed GERD.

Material and methods

The study included 100 subjects with confirmed GERD. They were chosen from consecutive patients who underwent 24-hour pH monitoring in a clinical setting. Each of the subjects had suffered from GERD symptoms for at least 3 months before the time of the diagnostic procedure. Patients receiving drugs that could potentially affect the symptoms studied and influence the pH-metric measurements or those with restricted locomotor abilities were excluded from analysis. During recruitment five patients met the exclusion criteria. The characteristics of the study group are presented in table 1.

The studied subjects had stopped acid suppressive therapy for at least 7 (H_2-blockers) or 14 days (proton pump inhibitors) before pH-monitoring. Each of them gave informed consent to the study. The measurements were performed using a dual electrode catheter with antimony electrodes with standard 10 cm spacing between them. Before pH-metry, the position of the lower oesophageal sphincter (LES) was established in manometry. The distal electrode was placed 5 cm above the proximal border of LES and the proximal electrode 15 cm above LES in the middle oesophagus. Thus there were two locations for monitoring of both distal and proximal pH. Each patient retained the pH probe and the pH recorder for a 24 hour period. The data acquired was analyzed with use of Polygram Net Software (Synectics Medical, GB). We assessed the number of reflux episodes, duration of the longest reflux episode, total time with pH <4.0 and DeMeester score. GERD was diagnosed when total time pH <4 was 3.4% or more and DeMeester score exceeded 14.75. On an additional chart subjects pointed to the GERD symptoms they experienced daily.

Before pH-metry the level of physical activity over the previous seven days was assessed using a self-administered short form of the International Physical Activity Questionnaire (IPAQ). The international validity and reliability evaluation of this questionnaire have been described previously [15]. A Polish version has been translated, back translated and checked by the IPAQ scientific group.

The amount of physical activity was expressed as multiples of resting metabolic rate by minutes of performance during a week (METs-minute/week) [16]. Using the IPAQ categorical scoring we distinguished three groups of subjects. Their level of physical activity was classified as: low (I), medium (II) and high (III). According to IPAQ criteria persons classified as highly active (group III) moved at least 12,500 steps a day or the equivalent in moderate or vigorous activities. This is at least an hour more moderate-intensity activity over and above the basal level of activity or half an hour of vigorous-intensity activity over and above basal levels daily (basal is 5000 steps/day). Group II had on average half an hour of at least moderate-intensity physical activity on most days. Group I did not meet any of the above criteria. Details of the scoring protocol are available on IPAQ web site [16].

All statistical analyses were performed with the use of Statistica 5.1 (1998, StatSoft, USA). The Shapiro-Wilk test was used to evaluate the normality of distribution. Data with a distribution deviating from normal (BMI, METs-minute/week, number of reflux episodes, duration of the longest episode, total time pH<4, DeMeester score) were successfully transformed using log base 10. For evaluation of relationships between everyday physical activity and pH-metric indices of GERD a multivariate regression analysis was performed. Studied parameters were adjusted for age, BMI, smoking and gender (as covariates). In order to determine associations among studied parameters, Pearson correlation analysis and partial correlation analysis (from the results of the multiple regression model) were carried out. Quantitative variables were assessed in Ch^2 test. The level of statistical significance was determined at $p < 0.05$.

Table 1

Characteristic of the study group. Subjects classified as: low (I), medium (II) and high (III) level of physical activity.

Group	I – low physical activity (n = 34)	II – medium physical activity (n = 35)	III – high physical activity (n = 31)	All subjects (n = 100)
Gender [n (male/female)]	15/19	22/13	22/9	59/41
Age [years]*	53.8 (12.7)	50.1 (14.0)	43.5 (13.2)	49.3 (13.9)
Height [cm]*	168.8 (7.7)	170.2 (8.5)	173.9 (10.4)	170.9 (9.1)
Body weight [kg]*	76.3 (14.0)	76.5 (14.9)	75.7 (13.6)	76.2 (14.1)
Body mass index (BMI) [kg/m^2]*	26.7 (4.3)	26.4 (4.7)	24.9 (3.2)	26.5 (4.2)
Cigarette smokers [n (% of the group)]	4 (12)	14 (40)	14 (45)	32(32)
Alcohol drinkers (≥1 drink a day) [n (% of the group)]	5 (15)	9 (26)	8 (26)	22(22)
Jobs that involve physical effort [n (% of the group)]	16 (47)	12 (34)	16 (52)	44(44)
Level of physical activity (METs-minute/week)*	400 (410)	1980 (1640)	8190 (4320)	3370 (4200)

* Data presented as: mean (SD).

Results

In a multivariate linear regression model adjusted for age, BMI, smoking and gender as covariates we did not observe any associations between the amount of everyday physical activity (expressed as log base 10 METs-minute/week) and pH-metric parameters of GERD evaluated 5 cm and 15 cm above LES (table 2, figure 1 and 2).

Furthermore, we analyzed relationships between investigated parameters and covariates: age, BMI, smoking and gender. We found significant correlations only between the number of reflux episodes 15 cm above LES and gender (beta –0.25; p <0.05) and between the number of reflux episodes 5 cm above LES and age (beta –0.24; p <0.05).

The number of self-reported symptoms did not differ among the three groups of different physical activity level. It reached 6 in groups I and II, and 7 in group III (p = 0.07). However we must note that we found a weak, positive correlation between the number of symptoms reported by patients and METs-minute/week (r = 0.21, p <0.05).

As expected, heartburn was the most common complaint and was present in 82% of cases. Subjects also reported chest discomfort (60%), fullness (57%) and hoarse voice (57%). The rarest symptoms were dysphagia (5%) and loss of appetite (4%) (figure 3).

Table 2

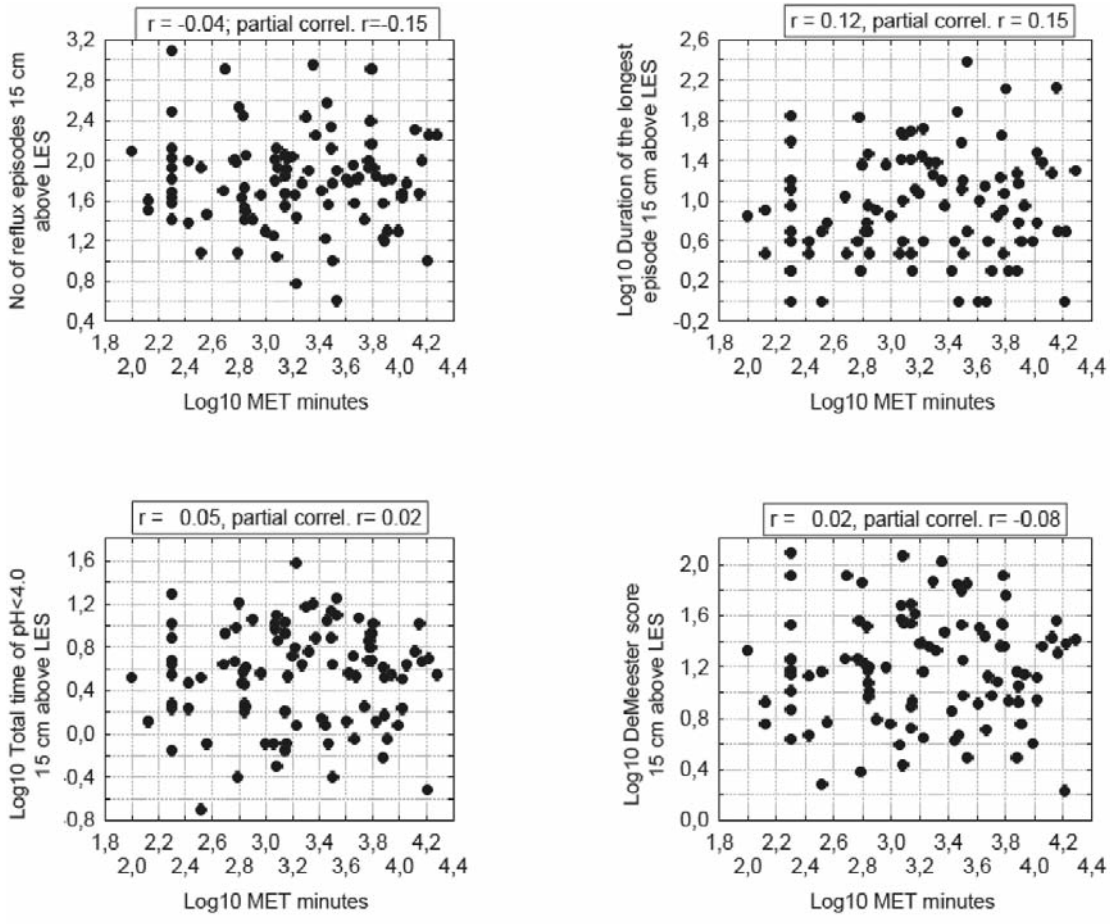
Comparison of pH-metric parameters among groups of low, medium and high level of physical activity and results of multivariate linear regression analysis.

pH-metric parameters		I – low physical activity (n=34)	II – medium physical activity (n=35)	III – high physical activity (n=31)	95% CI for beta value*
15 cm above LES	Number of episodes [n/24h]	140 (242)	97 (157)	116 (154)	<-0.28; 0.04>
	Max duration time [min]	13.0 (17.9)	20.9 (40.6)	21.3 (33.5)	<-0.10; 0.30>
	Total time pH<4.0 [%]	4.59 (4.2)	6.4 (7.5)	4.7 (3.7)	<-0.20; 0.16>
	DeMeester score	23.5 (26.1)	26.7 (29.0)	23.1 (20.1)	<-0.22; 0.10>
5 cm above LES	Number of episodes [n/24h]	199 (261)	150 (171)	174 (171)	<-0.19; 0.05>
	Max duration time [min]	29.1 (44.6)	37.8 (43.0)	36.7 (40.1)	<-0.07; 0.25>
	Total time pH<4.0 [%]	14.8 (11.9)	11.8 (7.2)	20.0 (36.8)	<-0.13; 0.11>
	DeMeester score	48.4 (45.9)	47.1 (33.8)	44.5 (29.7)	<-0.18; 0.10>

Data presented as mean (SD); LES – lower oesophageal sphincter. *95% confidence interval for effect of log base 10 METs-minute/week on outcome, adjusted for age, BMI, smoking and gender as covariates in multivariate linear regression analysis.

Figure 1

Correlations between the level of physical activity (METs-minute/week) and pH-metric parameters measured 15 cm above lower oesophageal sphincter (LES).



Discussion

Most estimations of the prevalence of GERD are approximate as the epidemiological criteria of the disease are usually limited to heartburn and regurgitation [4]. In spite of the fact that the specificity of the above symptoms is high – especially if they are experienced frequently – their presence does not necessarily mean that the disease is present. In our investigation heartburn was the most common symptom (it was present in 82% of cases), but regurgitation was reported by less than half of the subjects studied (49%). As 24-hour pH monitoring has the highest specificity for a diagnosis of GERD, we decided to enrol only subjects in whom GERD was confirmed by pH-metry. This is a possible advantage over epidemiological evaluations and the reason for our relatively small sample size.

Physical activity as well as cigarette smoking,

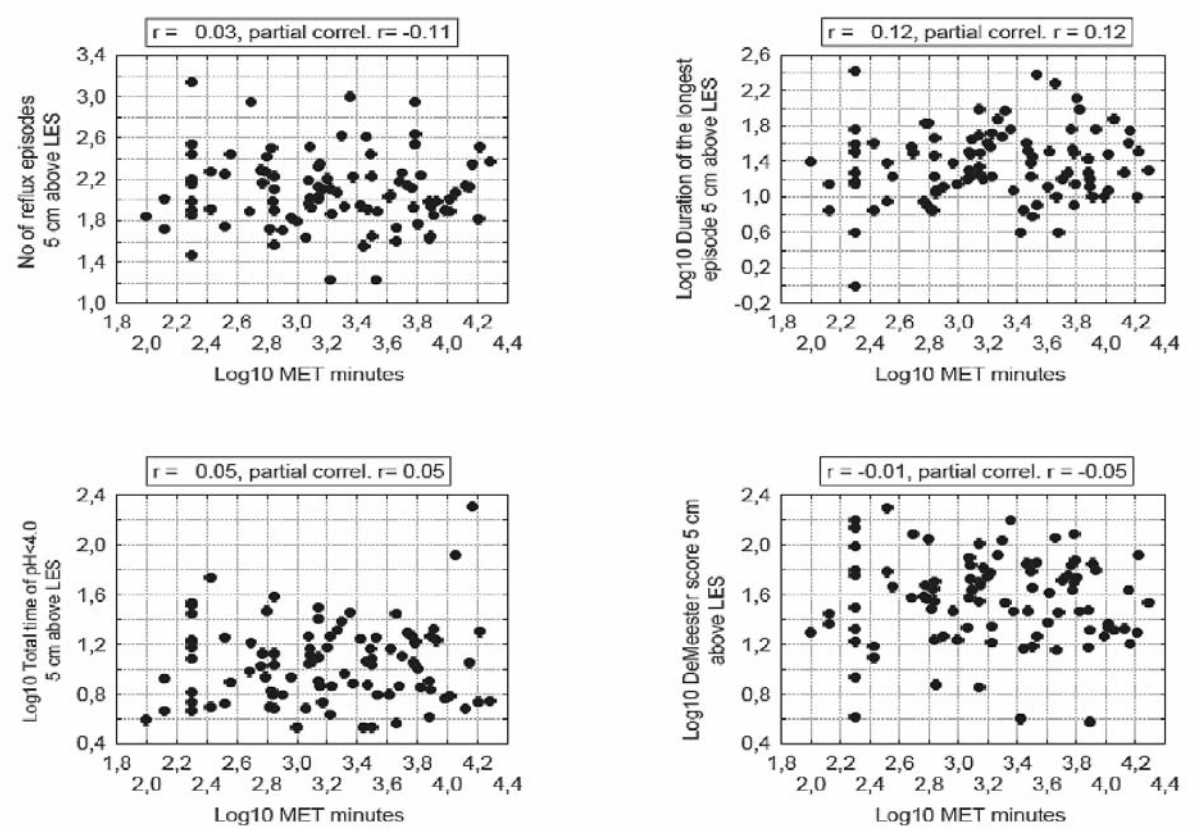


Figure 2

Correlations between the level of physical activity (METs-minute/week) and pH-metric parameters measured 5 cm above lower oesophageal sphincter (LES).

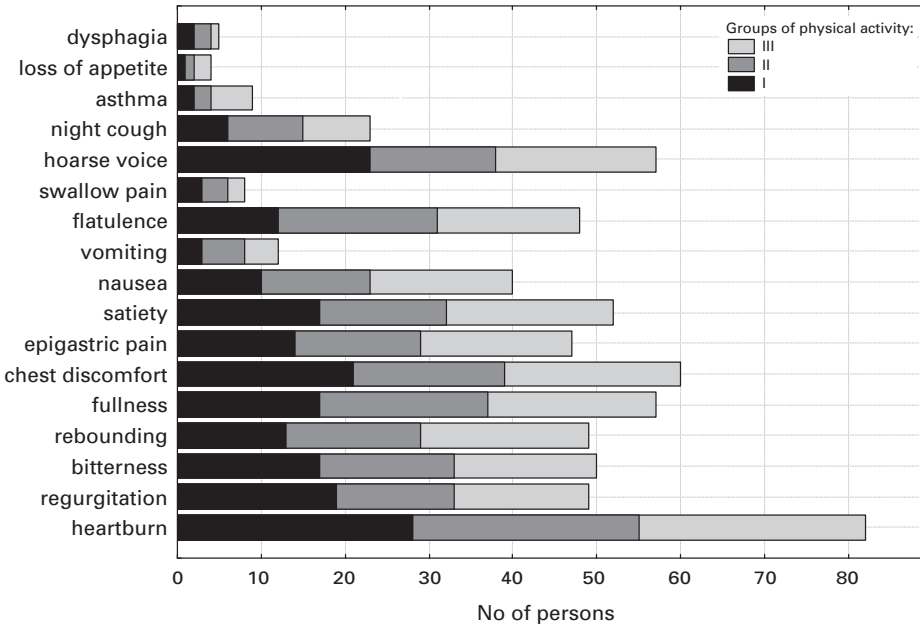


Figure 3

Correlations between the level of physical activity (METs-minute/week) and pH-metric parameters measured 5 cm above lower oesophageal sphincter (LES).

alcohol drinking and overweight is thought to play role in the aetiology of GERD. They are often recognized as factors that can induce gastroesophageal reflux [2, 17], though more recent studies do not support these findings [3, 9, 18, 19]. Exercise may alter oesophageal motility and worsen disturbances of the upper gastrointestinal (GI) tract [20]. In several observations of athletes, physical exercise was associated with increased frequency of gastroesophageal reflux and GERD symptoms [21]. In one study, 17 fit and healthy adults had intra-oesophageal pH-metry before, during and after rowing and running. They were also monitored after a light meal. Volunteers were asked to row, and to run with an empty stomach and after a meal. Gastroesophageal reflux was infrequent before exercise but it was induced in 70% of rowers, 45% of fasting runners and 90% of fed runners during and after exercise. The authors concluded that both running and rowing induce significant amounts of reflux in asymptomatic athletes [22]. Surprisingly, it has also been speculated that reducing meal volumes together with early postprandial physical activity might decrease the proximal extent of reflux and postprandial GERD symptoms [23].

Recently it has been postulated that relationships between everyday physical activity and GERD require better recognition [24, 25]. We decided to assign our study subjects to three groups that differed as to the level of physical activity. We used the IPAQ tool because of its proven ability to assess and compare physical activity and sedentary behaviours in populations aged 18–69 IPAQ score reflects the level of physical activity during "the last 7 days" which strictly correlates with "a usual week". We realize that it would be interesting to perform pH-metry in subjects simultaneously monitored with accelerometers.

In our investigation the mean weekly load of physical activity expressed as resting metabolic rate per minute of exercise was 400 (SD 410) in the least active (group I), 1980 (SD 1640) in moderately active (II) and 8190 (SD 4320) in highly active (III). This data coincided with daily hours spent sitting. It was 6.9 h (SD 2.5) in I, 5.9 h (SD 1.9) in II and 3.8 h (1.7) in III group. We found no association between physical activity and symptoms of GERD. In a multivariate linear regression model adjusted for age, BMI, smoking and gender as covariates we did not observe any association between the amount of everyday physical activity (expressed as log base 10 METs-minute/week) and pH-metric parameters of GERD. The only correlation that reached statistical significance was an association between physical activity (METs-minute/week) and subjective symptoms. However it was weak ($r = 0.21$; $p < 0.05$) and was not associated with significant differences as to the amount of reported symptoms among groups.

Our findings are concordant with results of an epidemiological survey within a population-based study of 100,000 residents of Olmsted County (Minnesota, USA). Of a randomly chosen 904 persons, 211 reported ailments typical for GERD (mean age 36 years, 43% males). Statistical analysis showed no significant association between symptoms and the level of physical activity measured by the Harvard Alumni Activity Survey [14].

Results obtained in studies performed in European countries brought different results. In a large-scale Norwegian survey of a population of over 74,000 individuals (aged 20 and over), a correlation was found between the number of exercise sessions lasting at least 30 minutes and decreased risk of GERD symptoms ($p < 0.0001$). Exercise once a week, as compared with no exercise, was associated with a 50% reduction of the risk of reflux. However the authors of the study admitted that there was no correlation between increments of exercise load and GERD [3].

In the German National Interview and Examination Survey (7,124 randomly selected subjects) persons with typical GERD symptoms were physically less active than subjects without symptoms, though the direction of this association was not clear. Contrary to the Norwegian study, physical activity exceeding 2 hours/week was positively associated with moderate and severe GERD symptoms (OR 0.75; 0.60–0.93 CI 95%; $p = 0.008$) [18].

Although most data prove that intense exercise exacerbates symptoms of GERD, the association between everyday or recreational physical activity and GERD is equivocal. Existing controversies may be a consequence of differences related to the populations studied (age, race), evaluation of exercise (short-term vs long-term), assessment of physical activity (diverse questionnaires) and diagnosis of the disease (symptom scale or pH-metry). We should recognise the possibility that physical activity is reduced because of GERD symptoms. This could be especially true for extreme physical efforts, but the question seems open for exercise of low or moderate intensity.

The results of the present investigation stand in concordance with other studies indicating only minor influence of lifestyle modifications on the course of GERD [19, 26].

Our observation should be confirmed in other populations with GERD diagnosed using pH-metric criteria. Increasing significance of GERD as a worldwide health burden warrants further investigation of the problem.

Correspondence:
Paweł Jóźków MD, PhD
Chair and Department of Sports Medicine
University School of Physical Education
ul. Paderewskiego 35, 51-612 Wrocław, Poland
E-Mail: jozkow@gmail.com, pjozkow@wp.pl

References

1 Fujiwara Y, Higuchi K, Watanabe Y, et al. Prevalence of gastroesophageal reflux disease and gastroesophageal reflux disease symptoms in Japan. J Gastroenterol Hepatol. 2005;20:26–9-

2 Isolauri J, Laippala P. Prevalence of symptoms suggestive of gastro-oesophageal reflux disease in an adult population. Ann Med. 1995;27:67–70.

3 Nilsson M, Johnsen R, Ye W, et al. Prevalence of gastro-oesophageal reflux symptoms and the influence of age and sex. Scand J Gastroenterol. 2004;39:1040–5.

4 Bruley Des Varannes S, Marek L, Humeau B, et al. Gastroesophageal reflux disease in primary care. Prevalence, epidemiology and Quality of Life of patients. Gastroenterol Clin Biol. 2006;30:364–70.

5 Locke GR 3rd, Talley NJ, Fett SL, et al. Prevalence and clinical spectrum of gastroesophageal reflux: a population-based study in Olmsted County, Minnesota. Gastroenterology. 1997;112:1448–56.

6 Regula J, Kulich KR, Stasiewicz J, et al. Burden of illness in Polish patients with reflux disease. Przegl Epidemiol. 2005;59:75–85.

7 Wiklund I, Carlsson J, Vakil N. Gastroesophageal reflux symptoms and well-being in a random sample of the general population of a Swedish community. Am J Gastroenterol. 2006;101:18–28.

8 Glise H, Hallerback B, Wiklund I. Quality of life: a reflection of symptoms and concerns. Scand J Gastroenterol Suppl. 1996;221:14–7.

9 Nandurkar S, Talley NJ. Epidemiology and natural history of reflux disease. Best Pract Res Clin Gastroenterol. 2000;14:743–57.

10 Collings KL, Pierce Pratt F, Rodriguez-Stanley S, et al. Oesophageal reflux in conditioned runners, cyclists, and weightlifters. Med Sci Sports Exerc. 2003;35:730–5.

11 Pandolfino JE, Bianchi LK, Lee TJ, et al. Esophagogastric junction morphology predicts susceptibility ot exercise-induced reflux. Am J Gastroenterol. 2004;99:1430–36.

12 Ravi N, Stuart RC, Byrne PJ, et al. Effect of physical exercise on oesophageal motility in patients with oesophageal disease. Dis Oesophagus. 2005;18:374–7.

13 Peters HP, Bos M, Seebregts L, et al. Gastrointestinal symptoms in long-distance runners, cyclists, and triathletes: prevalence, medication, and aetiology. Am J Gastroenterol. 1999;94:1570–81.

14 Nandurkar S, Locke GR 3rd, Fett S, et al. Relationship between body mass index, diet, exercise and gastro-oesophageal reflux symptoms in a community. Aliment Pharmacol Ther. 2004;20:497–505.

15 Craig CL, Marshall AL, Sjostrom M, et al. International physical activity questionnaire: 12-country reliability and validity. Med Sci Sports Exerc. 2003;35:1381–95.

16 International Physical Activity Questionnaire. Guidelines for data processing and analysis of the International Physical Activity Questionnaire (IPAQ) – short and long forms. November 2005. http://www.ipaq.ki.se

17 Locke GR 3rd, Talley NJ, Fett SL, et al. Risk factors associated with symptoms of gastroesophageal reflux. Am J Med. 1999;106:642–9.

18 Nocon M, Labenz J, Willich SN. Lifestyle factors and symptoms of gastro-oesophageal reflux – a population-based study. Aliment Pharmacol Ther. 2006;23:169–4.

19 Kaltenbach T, Crockett S, Gerson LB. Are lifestyle measures effective in patients with gastroesophageal reflux disease? An evidence-based approach. Arch Intern Med. 2006;166:965–71.

20 van Nieuwenhoven MA, Brouns F, Brummer RJ. The effect of physical exercise on parameters of gastrointestinal function. Neurogastroenterol Motil. 1999;11:431–9.

21 Parmelee-Peters K, Moeller JL. Gastroesophageal reflux in athletes. Curr Sports Med Rep. 2004;3:107–11.

22 Yazaki E, Shawdon A, Beasley I, et al. The effect of different types of exercise on gastro-oesophageal reflux. Aust J Sci Med Sport. 1996;28:93–6.

23 Emerenziani S, Zhang X, Blondeau K, et al. Gastric fullness, physical activity, and proximal extent of gastroesophageal reflux. Am J Gastroenterol. 2005;100:1251–6.

24 Jozkow P, Wasko-Czopnik D, Medras M, et al. Gastroesophageal reflux disease and physical activity. Sports Med. 2006;36:385–91.

25 Simons SM, Kennedy RG. Gastrointestinal problems in runners. Curr Sports Med Rep. 2004;3:112–6.

26 Meining A, Classen M. The role of diet and lifestyle measures in the pathogenesis and treatment of gastroesophageal reflux disease. Am J Gastroenterol. 2000;95:2692–7.

Established in 1871

Formerly: Schweizerische Medizinische Wochenschrift

Swiss Medical Weekly

Official journal of the Swiss Society of Infectious diseases, the Swiss Society of Internal Medicine and the Swiss Respiratory Society

The many reasons why you should choose SMW to publish your research

What Swiss Medical Weekly has to offer:

- SMW's impact factor has been steadily rising. The 2005 impact factor is 1.226.
- Open access to the publication via the Internet, therefore wide audience and impact
- Rapid listing in Medline
- LinkOut-button from PubMed with link to the full text website http://www.smw.ch (direct link from each SMW record in PubMed)

- No-nonsense submission – you submit a single copy of your manuscript by e-mail attachment
- Peer review based on a broad spectrum of international academic referees
- Assistance of our professional statistician for every article with statistical analyses

- Fast peer review, by e-mail exchange with the referees
- Prompt decisions based on weekly conferences of the Editorial Board
- Prompt notification on the status of your manuscript by e-mail
- Professional English copy editing
- No page charges and attractive colour offprints at no extra cost

We evaluate manuscripts of broad clinical interest from all specialities, including experimental medicine and clinical investigation.

We look forward to receiving your paper!

Guidelines for authors:
http://www.smw.ch/set_authors.html

EMH FMH Schwabe
Editores Medicorum Helveticorum

All manuscripts should be sent in electronic form, to:

EMH Swiss Medical Publishers Ltd.
SMW Editorial Secretariat
Farnsburgerstrasse 8
CH-4132 Muttenz

Manuscripts:	submission@smw.ch
Letters to the editor:	letters@smw.ch
Editorial Board:	red@smw.ch
Internet:	http://www.smw.ch