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# Epidemiology and costs of gastroesophageal reflux disease in Switzerland: a population-based study

**Summary**

**Objectives:** Assessment of the prevalence, health care resource use and cost of gastroesophageal reflux disease in Switzerland.
**Methods:** A population-based telephone survey was conducted in German and French speaking Switzerland. Reflux cases were defined using a questionnaire proposed by the German Gastro League and answered additional questions on their personal characteristics and resource use.
**Results:** 1274 out of 7222 participants were positively screened. The prevalence of reflux disease in Swiss adults was estimated at 17.6% (95% CI: 15.6%–19.7%) or 993000 individuals. Regular treatment with medication was reported by 38.0% of the reflux positive sample. Reflux-induced general practitioner consultations during the last year were reported by 25.9%. On average, there were 0.84 general practitioner consultations, 0.19 specialist consultations, 0.08 gastroscopies and 0.01 hospitalisations annually. Mean direct medical costs, dominated by medication costs, were CHF 185 per patient-year (95 % CI: CHF 140–230) or 0.5% of Switzerland's total health care expenditures. Total costs were CHF 234 (95% CI: CHF 185–284) per patient-year.
**Conclusions:** The prevalence of reflux disease in Switzerland is similar to that in other industrialised countries. Reflux disease causes considerable costs, in the medical system and at the societal level.

**Keywords:** **Gastroesophageal reflux – Epidemiology – Economics – Cost of illness – Switzerland.**

Recent studies addressing the epidemiology of oesophageal reflux disease have reported a tenfold increase in prevalence during the last 30 years (El-Serag & Sonnenberg 1998). During the same time span, reflux may have developed from a problem mainly affecting males to one being equally distributed between genders (Ter 2000).

Surveys in France, Great Britain, Italy, Sweden, and Germany have shown that 18% to 40% of the populations of these countries suffer from reflux symptoms (Kennedy et al. 1998; Rösch & Hotz 2000). U.S. prevalence figures are in the same range (Spechler 1992; Locke et al. 1997). Quality of life studies in patients with reflux disease show these to be seriously incapacitated (Rösch & Hotz 2000). Reflux disease is associated with a risk of developing Barrett's Esophagus (BE), and of subsequently developing adenocarcinoma of the oesophagus, with a very poor prognosis (Skinner et al. 1983).

The causes of the increase in reflux disease remain unclear. Environmental factors such as stress, stimulus satiation, and changes in dietary practices are discussed, as well as decreasing infection rates with Helicobacter pylori and the introduction of medications promoting reflux by relaxing the lower oesophageal sphincter (Lagergren et al. 2000).

The development of proton pump inhibitors (PPIs) has revolutionised the treatment of reflux disease and the approach to BE. PPIs allow for a continuous suppression of gastric acid production, generally achieving a healing of oesophagitis (Janknegt et al. 1999). In order to avoid recurrencies, costly continued treatment with this class of substances is usually necessary (O'Connor et al. 2000).

The overall economic impact of reflux disease appears to be significant. Cost of illness studies performed in the U.S. and Great Britain reported annual costs of several hundred Swiss francs per person (Levin et al. 1997; Eggleston et al. 1998). Information on the cost of illness of reflux disease in Switzerland has not been published so far.

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## Objectives

To address the epidemiology and economics of reflux disease in Switzerland, with a principal focus on prevalence, on the utilisation of health care resources, and on associated costs.

## Methods

*Data collection*

A population-based survey using computer-assisted telephone interviews (CATIs) was conducted in November 2000. Interviewees were selected and interviews performed by IPSO, Dübendorf, Switzerland, a company experienced in the field of health-related survey research and collaborator of several federal agencies including the Swiss Federal Statistical Office. All interviewers were part-time employees of IPSO. They had no medical training, but received a project-specific introduction and continuous supervision by the CATI lab's leading staff.

The target population were persons domiciled in the French- and German-speaking parts of Switzerland, aged 18 years or more. Interviewee selection was based on a two-step *random quota* procedure using an address database listing all Swisscom fixed telephone connections. A proportion of three German speaking households to one French speaking was maintained, reflecting the relative size of language groups in the Swiss population. Within households, one person was selected at random, but proceedings were modified to fulfil age and gender quota corresponding to the mean 1998 permanent resident population (Bundesamt für Statistik 1999). Households exclusively relying on mobile telephones and persons living in institutions could not be included. At the time of the survey, fixed telephone coverage was very high in Switzerland, with more than 4 200 000 fixed telephone connections in a population of 7.164 Million (Bundesamt für Kommunikation 2000).

Calls were made Monday to Friday from 5 p.m. to 9 p.m., thus ensuring a high availability of professionally active as well as other persons. 17654 telephone numbers were called. In 646 cases, there was no contact after 10 calls, or the number belonged to a modem/fax device or a company, or it was invalid. In 3592 cases, no person in the household met the age and gender quota requirements. 1102 interviews could not take place due to language problems or because the person selected was too old or ill. Of the remaining 12314 persons, 5092 (41%) refused or interrupted their interview. 7222 interviews (59%) were realised.

Screening was performed by recording reflux symptoms on the basis of a questionnaire (Tab. 1) developed and applied by the German Gastro League (Anonymous 2001). This instrument is referring to the present, without explicitly specifying a time span of observation. Focusing on heartburn and acid regurgitation, it comprises eight easily understandable questions divided into two sets of four. Persons answering at least one question in each set positively are defined as reflux cases.

All positively screened interviewees were questioned in greater detail to assess their utilisation of medical resources and direct medical costs. Absences from work were recorded to allow for the calculation of indirect costs. Additional sociodemographic, physiologic and anamnestic data were recorded to be used in the analysis of prevalence (age, gender, language region), in the description of the characteristics of the reflux positive sample (age, gender, height, weight, smoking status, presence of asthma, percentage of women pregnant during the observation period), and as potential influences on resource use and cost (all afore mentioned, education, employment status, household income, familial status, insurance status, urban or rural character of place of domicile) to be taken into account in multivariate analysis (Schneeweiss & Sangha 2000). Body mass index (BMI), smoking status, presence of asthma and pregnancy have been previously reported to be positively associated with the presence of reflux symptoms (Isolauri & Laippala 1995; Mokhlesi et al. 2001). Screening interviews lasted about five, in-depth interviews about 12 minutes.

*Cost analysis*

Cost of illness studies usually divide costs into direct costs, for which payments are made; indirect costs or losses of resources; and intangible costs related to facts that are difficult to express in monetary terms, e.g., the consequences of decreased quality of life (Rice 1994). Direct costs are estimated as the product of the number of services performed and their unit prices or charges. Following the human capital

**Table 1** Reflux checklist developed by the German Gastro League

| **Set 1: Questions 1–4** |
|---|
| 1. Do you have heartburn on several occasions during a month or do you experience burning in the throat? |
| 2. Do you sometimes wake up at night with heartburn? |
| 3. Do you get heartburn during sport or exertion? |
| 4. Do you often notice acid regurgitation – for example after eating? |
| **Set 2: Questions 5–8** |
| 5. Do you have heartburn more than twice a week or do you continually wake up during the night due to heartburn? |
| 6. Do you sometimes or regularly feel pain behind the breastbone that may radiate through to the back? |
| 7. Do you avoid certain foods or drinks for fear of heartburn? |
| 8. Do you regularly take medicines from the chemists shop against heartburn? |

approach, indirect costs are viewed as the value of reduced or lost productivity due to the disease in question. Intangible costs are difficult to assess and, as in most studies, were not included in our calculations.

Direct medical cost factors comprised outpatient costs (consultation costs and outpatient endoscopy costs), hospital costs and medication costs. All expenditures on these resources were taken into account independently of the payer (patient, third-party, or state). In this sense, a societal perspective of cost assessment was adopted.

All costs are indicated in their original currency and in Swiss currency (CHF). On November 30, 2000, at the end of the data collection period, CHF 1 equaled 0.57 US Dollars ($) and 0.40 British Pounds (£).

Regional tariff lists (*Kantonale Tarifvereinbarungen zwischen Ärzten und Krankenkassen*) valid in 1999 were used to estimate mean consultation costs. Conservatively assuming ordinary consultations without any particularities causing extra charges resulted in an approximation of CHF 24.50 for a consultation with a non-specialist as well as a specialist physician. Using the same lists, outpatient endoscopies were estimated to cost CHF 425 on average. It was assumed that, in cases of a suspected diagnosis of reflux disease, complete endoscopies of the oesophagus, stomach, and duodenum were performed, but biopsies and other additional procedures rarely needed.

A day on the general ward of a public hospital was reimbursed with an intercantonal mean of CHF 320 in 1999 (Konkordat der Schweizerischen Krankenversicherer 1999). Additional public subsidies to the Swiss hospitals amounted to CHF 4 700.5 Million in 1998 (Bundesamt für Statistik 2001). Assuming these subsidies to support hospitals' inpatient and ambulatory expenditures proportionally, and dividing the 90% share of inpatient expenditures by the estimated number of 1998 hospital days, results in a mean subsidy of CHF 300 per day (Bundesamt für Statistik 2002). The sum of CHF 620 is used as an estimate of average daily hospitalisation costs. This figure assumes that persons with a semi-private or private complementary insurance are not excluded from the benefits of public subsidies. Proceeding differently would be difficult as the exact proportion of these persons is not known (Bundesamt für Sozialversicherung 2000). Costs of reflux-related operations were not assessed additionally, as this would have raised a problem of double-counting.

Reflux-related medication costs during the 12 month period preceding the survey were directly estimated by our interviewees.

For the calculation of indirect costs, only the days off work of persons with a full- or part-time work contract, and of those self-employed or following a job-training were included. The costs of caring for relatives, of early retirement, and of premature death should also be accounted for in theory, but presumably can be neglected in the case of reflux. A one day absence from work was estimated to cost CHF 230, on the basis of a population-level standardised median salary of CHF 4988 as reported by the 1998 Salary Structure Survey of the Swiss Federal Statistical Office (Bundesamt für Statistik 1999).

*Statistical methods*

Sample weights were applied to correct for small deviations from the age and gender quota requested, thus allowing for population-adjusted prevalence estimates and ensuring comparability of the characteristics of the positively screened individuals with population-level data from other sources including the 1997 Swiss Health Survey (SHS '97). SHS '97 results, originally covering persons aged 15 or older, were recalculated by the Swiss Federal Statistical Office, to meet the age range of this survey.

All statistical analyses were performed using SPSS 10.0®. To analyse bivariate associations of categorical variables, odds ratios (ORs) were calculated. In case of one continuous variable, Mann-Whitney U tests and Kruskall-Wallis tests were used, due to the skewed distributions observed (Glick & Polsky 1999). Correlations of two continuous or ordinal variables were assessed by Spearman's correlation coefficient. Two-tailed $p = 0.05$ was used as the level of statistical significance. Confidence intervals (CIs) are given at the 95% level. As there was no access to the SHS '97 data at the individual observation level, comparisons with these were not based on statistical tests.

To further investigate significant bivariate associations and correlations of potential influence factors on direct medical costs, multivariate least squares regression on the logarithm of direct medical costs was performed. Before taking the logarithm, CHF 0.10 was added to all observations in order to avoid undefined values.

## Results

*Prevalence of reflux disease and history of illness*

The prevalence of reflux disease in the adult population was 17.6% (95% CI: 15.6% – 19.7%), based on 1274 cases among 7222 persons aged at least 18 years who were interviewed. Using these data, the number of persons in Switzerland with reflux disease can be estimated at approximately 993000 (95% CI: 944000 – 1043000).

Of the persons interviewed, 5538 (76.7%) lived in the German-speaking part of Switzerland, and 1683 (23.3%) lived

in the French-speaking part. The proportion of the positively screened was 16.4% in the German-speaking part (907 persons) and 21.9% in the French-speaking part (368 persons). This translates into a statistically significant OR of 1.34 (95% CI: 1.20–1.49).

There was a constant but moderate rise with age, from 11.7% in those aged 18 to 29 to a peak of 23.1% in persons of age 70 to 79 (Tab. 2). The highest age group (80 and over) reported a lower prevalence of 18.7%.

The proportion of the positively screened was 18.2% in the women and 17.1 % in the men, corresponding to a non-significant OR of 1.11 (95 % CI: 0.97–1.25).

Mean disease duration was 9.8 years (median 6 years). Stratification by 10-year age groups shows mean values ranging from 3.1 years in those aged 29 or younger to 14.2 years in those aged 70–79 (Tab. 2). Here too, persons aged 80 or older reported a lower figure. Medians followed a similar pattern.

*Sociodemographic, physiologic and anamnestic variables*

Table 3 shows characteristics of the persons identified to suffer from reflux disease. These are contrasted to population level estimates derived from all 7 222 interviews of this survey if available, or from the SHS '97.

Mean age was slightly but significantly higher in the positively screened persons ($p < 0.0005$). The share of women was 2.0% higher in the positively screened group, which corresponds to a non-significant OR of 1.11 (95% CI: 0.97–1.25).

Both absolute body weight and BMI results suggest a distinctly higher proportion of overweight persons in the reflux positive compared to the general population. A history of current or past smoking was reported by 48.6% of the reflux positive persons, compared to 52.6% in the SHS '97. Reflux positive interviewees reported to suffer from asthma in 110 cases (8.6%).

**Table 2** Prevalence and disease duration by 10–year age intervals

| Age | N (total) | N (reflux positive) | Prevalence | | Disease duration (years) | |
|---|---|---|---|---|---|---|
| | | | % | (95 % CI) | Mean ± standard deviation | Median |
| All ages | 7 222 | 1 274 | 17.6 | (15.6–19.7) | 9.8 ± 10.6 | 6 |
| 18–29 | 745 | 87 | 11.7 | (9.4–14.0) | 3.1 ± 2.7 | 2 |
| 30–39 | 1 438 | 211 | 14.7 | (12.9–16.5) | 6.2 ± 5.5 | 5 |
| 40–49 | 1 440 | 246 | 17.1 | (15.2–19.0) | 9.4 ± 8.1 | 8 |
| 50–59 | 1 263 | 249 | 19.7 | (17.5–21.9) | 9.9 ± 9.2 | 7 |
| 60–69 | 961 | 193 | 20.1 | (17.6–22.6) | 11.7 ± 11.2 | 8 |
| 70–79 | 736 | 170 | 23.1 | (20.1–26.1) | 14.2 ± 14.2 | 10 |
| ≥ 80 | 638 | 119 | 18.7 | (15.7–21.7) | 12.4 ± 15.5 | 5 |

**Table 3** Characteristics of positively screened persons and population level estimates

| Variable | Positively screened persons (N = 1 274) | Population aged 18 or older | Source of population-level estimate |
|---|---|---|---|
| | Average value ± standard deviation or % | | |
| Age (years) | 49.4 ± 17.3 | 46.7 ± 18.0 | N = 7 222 [a] |
| Women (%) | 53.4 | 51.8 | N = 7 222 [a] |
| Height (cm) | 170.0 ± 11.3 | 169.7 | SGB '97 [b] |
| Weight (kg) | 71.8 ± 14.7 | 69.8 | SGB '97 [b] |
| BMI groups (%) [c] < 20 | 9.2 | 12.0 | SGB '97 [b] |
| = 20, <25 | 46.0 | 51.8 | |
| = 25, <30 | 35.0 | 29.1 | |
| = 30 | 9.8 | 7.1 | |
| History of smoking (%) | 48.6 | 52.6 | SGB '97 [b] |
| Asthma (%) | 8.6 | 3.1 | SGB '97 [b] |
| Presence of pregnancy in women aged 18 – 45 years (%) | 6.0 | – | not available |

[a] All interviewees of our telephone survey
[b] Swiss Federal Statistical Office, 1997 Swiss Health Survey. Reference: persons aged 18 or older. Standard deviations not available
[c] Unit of BMI: kg/m$^2$

*Utilisation of medical resources*

Only 796 (62.4%) of the reflux cases reported to "do something against the disease". Regular treatment with medication was reported by 458 (38.0%). Information on the names of the drugs used was provided by 349 persons, of which 114 (32.6%) took prescription drugs. Combining these figures lead to an estimate of 11.8% of the persons with reflux taking prescription drugs (mainly PPIs) regularly.

Treatment by a general practitioner in the 12 months preceding the survey was reported by 330 (25.9%) patients, who saw their doctor 3.1 times on average (95% CI: 2.7–3.5, median 2). The maximum number of consultations due to reflux was 25. Specialists were consulted up to 12 times by 134 patients (10.6%), 1.8 times on average (95% CI: 1.6–2.1, median 1.8). A history of gastroscopy was reported by 382 patients (30.0%). This procedure took place within the previous year in 95 patients (7.5%). A history of reflux-related hospitalisation was reported by 55 persons (4.3%), and by 14 patients (1.1%) with reference to the previous year. Mean duration of hospitalisation was 9.7 days (median 7). Hospitalisations during the year preceding the survey only lasted 6.3 days (median 4.8).

Mean consultation frequencies for all positively screened persons and utilisation frequencies of other health care resources are shown in Table 4. At this level, medians were 0 for all resource use variables, due to heavily right-skewed distributions.

Reflux-related absences from work during the last 12 months were remembered by 48 persons (3.8% or 7.7% of those being professionally active or on a job training). Mean duration of absence from work was 5.6 (median 2.3) days, which corresponds to 0.4 (median 0) days per year in the professionally active, and to 0.2 (median 0) days per year in all positively screened persons.

*Costs of gastroesophageal reflux in Switzerland*

*Direct costs:* The mean contribution of different cost parameters to reflux-associated direct medical costs is shown in Table 5. Medians were CHF 0, due to heavily right-skewed distributions. This was mirrored in the reflux-associated direct medical costs themselves. These amounted to CHF 185 (95% CI: CHF 140–230) per year on average, and were clearly dominated by medication costs, with hospital, endoscopy, and general practitioner costs being second to fourth in importance.

Higher direct medical costs were weakly correlated with age (Spearman's correlation coefficient 0.16, $p < 0.005$) and disease duration (Spearman's correlation coefficient 0.07, $p = 0.013$). Correlations with weight (0.01, $p = 0.745$) and BMI (0.05, $p = 0.092$) were not statistically significant. There was virtually no cost difference between men and women (CHF 184 vs CHF 186, $p = 0.835$). Cost differences between persons with and without a history of smoking (CHF 156 vs CHF 213, $p = 0.930$), and between asthma patients and non-asthma patients (CHF 217 vs CHF 182, $p = 0.500$) were not statistically significant.

Higher costs in the French versus German speaking areas (CHF 191 vs CHF 183) and in persons living in urban versus rural surroundings (CHF 235 vs CHF 150) reached statistical significance ($p = 0.018$ and $p = 0.020$). The level of education also had a significant effect on treatment costs ($p = 0.046$). Persons having completed compulsory education and/or a professional training incurred costs of CHF 203 per year, those with a high school diploma incurred costs of CHF 121, and those with a technical school diploma or a university degree costs of CHF 154. Costs of persons with statutory health insurance were CHF 187 per year on average, whereas persons with an additional semi-private or private insurance incurred costs of CHF 174 and CHF 228 per year, respectively ($p = 0.270$). Correlation with houshold income was negative, but weak and non-significant (Spearman's correlation coefficient -0.05, $p = 0.165$).

Multivariate least squares regression on the logarithm of direct medical costs confirmed that all associations and correlations found to be significant in bivariate analysis were also significant or near-significant in regression, with their directions unchanged. Disease duration was the only exception. Other potential influences did not reach p-values < 0.20. The

**Table 4** Utilisation of medical services and absences from work due to reflux disease, per patient-year (N = 1 274)

| Resource | No. of patients using resource or being affected during reference period | Units consumed | Rate/patient/year | |
|---|---|---|---|---|
| | | | Mean | 95% CI |
| General practitioner consultations | 330 (25.9%) | 1 071 | 0.84 | 0.71–0.97 |
| Specialist consultations | 134 (10.6%) | 245 | 0.19 | 0.15–0.23 |
| Endoscopies | 95 ( 7.5%) | 95 | 0.08 | 0.06–0.09 |
| Hospitalisations | 14 ( 1.1%) | 14 | 0.01 | 0.01–0.02 |
| Hospital days | – | 91 | 0.07 | 0.01–0.13 |
| Days off work | 49 ( 3.8%) | 272 | 0.21 | 0.12–0.30 |

**Table 5** Costs of reflux disease in Switzerland, per patient-year (N = 1274)

| Resource | Costs/patient/year (CHF) | |
|---|---|---|
| | Mean | 95 % CI |
| General practitioner consultations | 21 | 17–24 |
| Specialist consultations | 5 | 4–6 |
| Endoscopies | 32 | 26–38 |
| Medication | 84 | 63–104 |
| Total ambulant costs | 141 | 117–165 |
| Hospital costs | 44 | 8–80 |
| Direct medical costs | 185 | 140–230 |
| Indirect costs | 49 | 28–70 |
| Total costs | 234 | 185–284 |

explanatory power of all possible models remained minimal, with R-squared values consistently below 0.05. Table 6 shows the final model.

*Indirect costs:* Calculation based on reflux-related days off work as reported by our interview partners lead to an estimate of mean indirect costs of CHF 49 (95% CI: CHF 28–70) per person-year for all reflux cases, and of CHF 90 (95% CI: CHF 52–128) per person-year in those professionally active or on a job training. Medians were 0 in both cases.

*Total costs:* Total costs summed up to CHF 234 (95% CI: CHF 185–284) per person-year.

*Extrapolation to the whole of Switzerland*

Assuming 993000 Swiss persons with reflux disease lead to an estimate of the total costs of reflux disease in Switzerland of CHF 0.23 billion per year. Direct medical costs amounted to CHF 0.18 billion per year.

According to the Swiss Federal Statistical Office, total health care expenditures in Switzerland amounted to CHF 39.8 billion in 1998 (Bundesamt für Statistik 2001). Thus, the direct medical costs of reflux disease account for approximately 0.5% of total Swiss health care expenditures.

**Table 6** Multivariate least squares regression on the logarithm of direct medical costs (N = 1 266[a])

| F(5,1266) = 8.587<br>R-squared = 0.033<br>Covariates | Prob > F = 0.000<br>Adjusted R-squared = 0.029<br>Coef. | 95 % CI | |
|---|---|---|---|
| Age | 0.024 | 0.012 | 0.035 |
| German language region[b] | – 0.764 | – 1.188 | – 0.340 |
| Rural dwelling[c] | – 0.478 | – 0.865 | – 0.091 |
| Education: | | | |
| High school[d] | – 0.256 | – 0.859 | 0.347 |
| University or equivalent[d] | – 0.679 | – 1.189 | – 0.168 |
| Intercept | 0.992 | – 0.221 | 2.205 |

[a] N < 1 274 due to missing values
[b] Compared to French language region
[c] Compared to urban dwelling
[d] Compared to compulsory education and/or professional training

## Discussion

The main methodological issues to be addressed are the advantages and disadvantages of population-based data collection, the choice of risk score, and cost assessment.

*Data collection:* Any approach to the study of reflux disease relying solely on medical records would necessarily underestimate prevalence at the population-level and overestimate resource use per person, as many of those affected do not seek medical assistance. A population-based approach to data collection is necessary. Thus, the distortions occurring if non-representative samples of study participants are recruited in physician's offices can largely be avoided. In addition, out-of-pocket expenses never showing up in medical records can be accounted for. On the other hand, population-based data collection has its own pitfalls, the most important being limited quality of information, recall bias and selection bias.

The most important potential reason of selection bias despite correct sampling is non-response. Comparisons of face-to-face, mailed and telephone surveys addressing health-related issues showed small differences between modes of administration and small non-response effects with respect to prevalence estimates (Marcus & Crane 1986; O'Toole et al. 1986). Non-response in telephone surveys was found to be less content-oriented than in mailed surveys (Fowler et al. 2002). Also, bias due to different sociodemographic characteristics of persons inaccessible by telephone affected reports of illness and related use of services only marginally, if the general population was addressed and if telephone coverage was at least 90% (Marcus & Crane 1986; Ford 1998). It can be assumed that these preconditions were fulfilled in Switzerland at the time of our data collection, when exclusive use of mobile phones was still infrequent. Persons living in institutions could not be included, which would be critical in the study of a disease affecting the higher ages differentially or directly causing institutionalisation. In the case of reflux, it should be of minor importance. The overall risk of relevant selection bias can be assumed to be relatively small in this study.

Information quality clearly is a more critical problem. Assessments of health related issues and resource use by survey methods are prone to error and recall bias. Comparisons with medical records have revealed relevant potential shortcomings, notwithstanding the fact that the completeness and correctness of medical record information is an issue in itself

(McKinnon et al. 1997). Studies of chronic conditions like lower back pain and asthma hint at a moderate underreporting of medium to long term prevalence, in the range of 5–20%, while forward telescoping of earlier events may partially compensate for this effect (Carey et al. 1995; Mathiowetz & Dipko 2000). Recall of resource use has been observed to deteriorate seriously after 10 months, and up to 20% of information may be lost after one year (Brown & Adams 1992). Reports of the exact number of disease-specific and overall physician consultations during the previous 12 months differed from medical record-based information in up to 70% of cases, but similar rates of under- and overreporting greatly reduced overall error (McKinnon et al. 1997; Mathiowetz & Dipko 2000). Hospitalisations and their causes were well remembered, while the validity of reports of drug use was judged more critically (Brown & Adams 1992). All modes of administration seem to be affected by these problems in about the same way, despite some advantages of face-to-face and telephone interviews in comparison with mailed questionnaires (Marcus & Crane 1986; O'Toole et al. 1986; McKinnon et al. 1997; Galobardes et al. 1998; Brogger et al. 2002).

In summary, collection of health-related data in general populations using survey methods is an accepted, while not entirely unproblematic alternative to medical record review (Marcus & Crane 1986; Brown & Adams 1992). It was justified in this study as a medical record-based approach could not have produced population-level estimates. Nevertheless, some measurement error and bias may be present in the results. Reports of earlier studies indicate that this may have induced an under- as well as an overestimation of some parameters, but probably no major distortions.

*Choice of risk score:* A variety of questionnaires have been used to measure the presence of reflux disease. These were designed to be used in self-reporting (Isolauri & Laippala 1995; Ledson et al. 1998), in face-to-face interviews with trained interviewers (Eggleston et al. 1999), or in physician interviews (Klauser et al. 1990). Until today, no standard has emerged, and results strongly depend on the reference periods used, ranging from one day to one year (Isolauri & Laippala 1995). All instruments address heartburn and acid regurgitation, while in part considering additional symptoms such as dysphagia, globus, nausea, belching, or chest-pain. Validation is complicated by a lack of gold standard, as even invasive procedures such as pH monitoring and gastroscopy are of limited sensitivity and specifity (Johnsson et al. 1987; Klauser et al. 1990). Only the instruments developed by Andersen et al. (1987) and Locke et al. (1994) and, to a certain extent, the DIGEST instrument have been formally validated (Eggleston et al. 1999). All three are clearly too extended to be used in a population-based screening study using CATIs. Measures specifically designed or validated for use in a CATI framework are not available. The questionnaire by Locke et al. was used in a telephone setting once, but for reassessment purposes only (Newton et al. 1999). Facing the lack of a formally validated instrument suitable for this study, we selected a measure which relied on easily understandable questions with good face value. It covered the symptoms jointly addressed by all instruments proposed, and it could be assessed by phone without problems, renouncing highly elaborated formal definitions in favour of interviewee compliance.

*Cost assessment:* Cost assessment can follow a top-down or a bottom-up approach (Tolpin & Bentkover 1983). The latter derives healthcare costs from aggregated sources (e.g., national statistical records). Due to a lack of central databases, this approach can hardly be adopted in Switzerland. The bottom-up approach, which we used, determines resource use at the single patient level and multiplies *per capita* resources with the appropriate epidemiological figures like prevalence or incidence. Using a population-based approach to derive these figures allows for a relatively high degree of external validity. Assessment of unit costs, however, often has to be based on approximations. This is particularly true for Switzerland's very decentralised health care system.

Medication costs dominate medical resource costs in reflux disease. Interviewees' estimates of these costs are certainly far from being exact. In diseases mainly requiring continuous medication, it would be more appropriate to ask for the daily doses, to which public prescription prices could be applied. Treatment of reflux disease, however, is in many cases characterised by on demand medication, whose intensity may be remembered in even less detail. Direct estimates should be more reliable under such circumstances.

*Epidemiologic results:* Most of our epidemiologic results are a confirmation of previous findings from other industrialised countries. Our prevalence estimate of 17.6%, referring to the adult population, is in the range to be expected from many studies (Spechler 1992; Locke et al. 1997; Kennedy et al. 1998; Rösch & Hotz 2000; Ter 2000). The findings of the Domestic/International Gastroenterology Surveillance Study (DIGEST), however, contradict our result (Eggleston et al. 1999; Stanghellini 1999). Based on 5600 interviews in 10 industrialised countries, DIGEST found an overall prevalence of reflux-like symptoms of 7.7%, and a prevalence in Switzerland of 4.8% (Stanghellini 1999). Several metho-

dological differences contribute to the explanation of this discrepancy: The Swiss DIGEST sample comprised 500 persons only, living in some few urban agglomerations (Eggleston et al. 1999). A reference period of three months was used. Reflux symptoms had to reach a certain level of "relevance" to be counted, and were not considered if other upper gastrointestinal (GI) symptoms were more prominent. Total Swiss prevalence of relevant upper GI symptoms was found to be 17.7 % (Stanghellini 1999).

The observation of a significantly higher prevalence rate in the French speaking part of Switzerland may be due to a real epidemiologic difference or due to a higher awareness of reflux disease in this region.

A rise of reflux prevalence with age has been previously reported (Isolauri & Laippala 1995; Eggleston et al. 1999). Spechler (1992) even found a dramatic increase in those over age 40. Our additional finding of a reduced prevalence in the highest age group, which has not been described before, can be assumed to be an artefact. It possibly results from a reduced awareness of reflux due to an increased presence of other, more threatening health problems. Disease duration also rose with age, but had lower values in the highest age group. Recall bias may be an important factor here. Nevertheless, our results suggest that disease duration is limited in many cases, or at least that disease intensity often regresses to a level which is not remembered over prolonged periods of time. Reflux disease develops at all adult ages. The absence of a gender gap in the reflux-positive sample is consistent with the findings of several observational studies (El-Serag & Sonnenberg 1998; Kennedy et al. 1998; Eggleston et al. 1999; Ter 2000).

Comparisons of our data with population-level estimates from the SHS '97 (Table 3) may be affected by selection bias in one or both data sources. If no relevant distortions of this kind are assumed, our results support an association between reflux and overweight, which is controversial in the literature, but confirmed by DIGEST (Isolauri & Laippala 1995; Eggleston et al. 1999; Lagergren et al. 2000). Some studies reported an increased prevalence of reflux disease in persons with a history of smoking and, nearly undisputed, a negative influence of smoking on disease severity (Isolauri & Laippala 1995; Pandolfino & Kahrilas 2000). Thus, the finding of a reduced number of smokers in the reflux-positive persons compared to the SHS '97 estimate could potentially result from an influence of reflux symptoms on smoking habits. The asthma prevalence in the reflux-positive interviewees of 8.6 % is best compared with an earlier report of a prevalence of 6.7 % in the adult Swiss population (Leuenberger 1995). A positive association between reflux disease and asthma has been reported earlier (Mokhlesi et al. 2001).

Our population-level estimate of 993 000 persons with reflux disease in Switzerland is conservative as it does not include persons under 18 years of age with reflux.

*Cost results:* Our cost estimates are seemingly low. While several of the methodological issues addressed above may have contributed to this, the main reason lies in the fact that we included all reflux-positive persons identified, unregarding the question if they were medically treated or not. During the 12 months preceding their interview, only 26 % of our reflux positive sample reported a general practitioner consultation due to this condition. Studies only including persons undergoing medical treatment must yield higher resource use and cost estimates. This is the case in most research addressing the economics of reflux disease (Viljakka et al. 1997; Sonnenberg et al. 1999; Gerson et al. 2000). Eggleston et al. (1998), e.g., refer to a period of initial medical activity. They report costs in the range of £ 136 to £ 189 (CHF 341 to CHF 474) and a mean of 2.4 to 2.9 general practitioner consultations during six months. We observed 3.1 consultations per one year in those interviewees who reported reflux-induced consultations. (Except by chance, these were not in their initial treatment phases.) Levin et al. (1997) found annual treatment costs in the range of $ 471 (CHF 826) in a U.S. managed care setting. Our results, referring to a population with a distinctly lower mean intensity of disease and being based on a different health care system, are compatible with these findings.

Most significant bivariate associations we found between direct medical costs and possible influence variables (age, language region, urban or rural dwelling, educational level) were confirmed in regression analysis. Our observation of a moderate rise of costs with age can be assumed to be of indirect nature. Longer disease duration in older persons may be the true reason. Higher costs of reflux disease in the French compared to the German language region probably are a reflection of higher total health care costs (Frei & Tinturier 1996). An above-average density of health care providers may have contributed to the observation of higher costs in urban areas. Despite their plausibility, the explanatory value of all influences identified is minimal. Treatment intensity may largely be ruled by personal attitudes of the patients and physicians involved, and chance may also have an important role. Other studies might try to find better explanatory variables than those we measured, to allow for a better prediction of costs.

In addition, further methodological research should in greater depth address the difficulties and relationship of medical record-based and survey-based collection of health-related data. Optimised future study designs might combine the use of

survey methods for case identification and of medical record review for the collection of resource use and additional data. Epidemiologic, resource use and cost results demonstrate that reflux disease is of considerable importance medically, but also economically. Our estimate of reflux disease accounting for approximately 0.5% of the total Swiss health care expenditures has probably to be viewed as conservative, due to the implications of study design.

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**Zusammenfassung**

**Epidemiologie und Kosten der gastroösophagealen Refluxkrankheit in der Schweiz: eine bevölkerungsbasierte Studie**
**Fragestellung:** Messung der Prävalenz, des medizinischen Ressourcenverbrauchs und der Kosten der gastroösophagealen Refluxkrankheit in der Schweiz.
**Methoden:** In der deutschsprachigen und französischsprachigen Schweiz wurde eine bevölkerungsrepräsentative Telefonumfrage durchgeführt. Personen mit Reflux wurden anhand eines von der Deutschen Gastro-Liga vorgeschlagenen Fragebogens identifiziert und beantworteten zusätzliche Fragen zu ihren persönlichen Charakteristika und zum medizinischen Ressourcenverbrauch.
**Ergebnisse:** 1274 von 7222 TeilnehmerInnen wurden als Refluxfälle definiert. Die Prävalenz der Refluxkrankheit unter Schweizer Erwachsenen wurde auf 17.6% (95%-KI: 15.6%–19.7%) oder 993000 Personen geschätzt. Eine regelmässige medikamentöse Behandlung wurde von 38.0% dieser Personen angegeben. Durch Reflux bedingte Allgemeinarztkonsultationen während des letzten Jahres wurden von 25.9% berichtet. Im Durchschnitt betrug die Zahl der Allgemeinarztkonsultationen 0.84, die Zahl der Spezialistenkonsultationen 0.19, die Zahl der Gastroskopien 0.08 und die der Hospitalisationen 0.01 pro Patientenjahr. Die durchschnittlichen direkten medizinischen Kosten wurden durch die Medikamentenkosten dominiert und betrugen CHF 185 pro Patientenjahr (95%-KI: CHF 140–230) oder 0.5% der gesamten Gesundheitsausgaben der Schweiz. Die totalen Kosten beliefen sich auf CHF 234 (95%-KI: CHF 185–284) pro Patientenjahr.
**Schlussfolgerungen:** Die Prävalenz der gastroösophagealen Refluxkrankheit in der Schweiz ähnelt der in anderen industrialisierten Ländern beobachteten. Die Kosten der Refluxkrankheit sind sowohl auf der medizinischen als auch auf der gesellschaftlichen Ebene beträchtlich.

**Résumé**

**Epidémiologie et coûts du reflux gastro-oesophagien en Suisse: une étude dans la population générale**
**Objectifs:** Evaluation de la prévalence, de la consommation de prestations médicales et des coûts du reflux gastro-oesophagien en Suisse.
**Méthodes:** Une enquête téléphonique a été menée dans la population générale en Suisse alémanique et Suisse romande. Les cas de reflux on été identifiés en utilisant un questionnaire proposé par la ligue allemande contre les maladies gastriques et interrogés sur leurs caractéristiques personnelles et leur consommation de prestations médicales.
**Résultats:** On a dépisté 1274 cas positifs sur 7222 participants. La prévalence du reflux parmi les adultes en Suisse a été estimée à 17.6% (IC 95%: 15.6%–19.7%), correspondant à 993000 personnes. Un traitement médicamenteux a été suivi par 38.0% des cas positifs, et 25.9% ont déclaré d'avoir consulté leur médecin généraliste pour cause de reflux pendant l'année précédente. En moyenne, on a dénombré 0.84 consultations au cabinet généraliste, 0.19 consultations d'un spécialiste, 0.08 gastroscopies et 0.01 hospitalisations par personne-année. Les coûts médicaux directs, dominés par les coûts médicamenteux, se sont montés en moyenne à CHF 185 par personne-année (IC 95%: CHF 140–CHF 230) ou à 0.5% des dépenses de santé en Suisse. Les coûts totaux ont été de CHF 234 (IC 95%: CHF 185–CHF 284) par personne-année.
**Conclusions:** La prévalence du reflux gastro-oesophagien en Suisse est comparable à celles des autres pays industrialisés. Le reflux est à l'origine de coûts considérables au niveau du système de santé et au niveau de la société.

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