CONTRIBUTION OF EPIDEMIOLOGY IN POLAND FOR BETTER UNDERSTANDING OF THE NATURAL HISTORY OF DISEASES IN GASTROINTESTINAL TRACT

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Descriptive epidemiologic studies on the geographical distribution of gastrointestinal diseases in Poland have been conducted in our country since several decades. One of the first descriptive analyses was cancer study in 1967, where age-standardized mortality rates in various regions of Poland by gender and area of residence (urban/rural) were presented. Since 1970 analytical epidemiologic studies aiming at explaining the natural course of various diseases within gastrointestinal tract started to produce interesting results. The first study in this field was the case-control study on the occurrence of peptic ulcer and tobacco smoking performed in 1974. The study provided one of the first epidemiologic evidence on the harmful effect of tobacco smoking in the etiology or peptic ulcers. Subsequent studies dealt with the importance of dietary habits and life style (tobacco smoking and vodka drinking) in the occurrence of gastric cancer. The studies confirmed previous findings that consumption of raw vegetables and fresh fruit is inversely related to risk for stomach cancer in Poland. In addition the results demonstrated, that dietary practices such as the modality of cooking the food, preparation of food products and storing conditions were connected with stomach cancer risk. These factors have also been found to influence the risk for stomach cancer in Poland. The main message of this latter study was that the family as a whole is affected by many risk factors for stomach cancer and families in which stomach cancer has occurred should be therefore targets for preventive measures. Interestingly, analysis of life style factors such as tobacco smoking or vodka drinking has showed that the risk for cardia cancer increased considerably for smokers of cigarettes without filters and in those who consumed large amounts of vodka. For the non-cardia region a uniform increase of risk could be observed for vodka drinking, regardless of cigarette smoking status. The findings of this study suggested the hypothesis that the effect of tobacco smoking and vodka drinking may be different for cardia cancer compared to the distal cancers. Our clinico-epidemiological study suggest that infection with Helicobacter pylori is not sufficient factor for inducing precancer changes in gastric mucosa. Besides, case-controls studies on dietary habits and physical activity level in the etiology of colorectal cancer are in progress. The preliminary results demonstrated the protective
The occurrence of diseases in gastrointestinal tract is related to a large extent to environment (Fig. 1) and this fact must be considered in epidemiologic studies searching for the influence of various environmental risks. The concept of "environment" is to be understood in broad sense, i.e. comprising the entire surroundings of man. This has not only to include the quality of soil, water and air, but also other factors such as occupation, exposure to chemicals, housing and also lifestyle habits (tobacco smoking and alcohol consumption, dietary habits, food quality etc.).

**Descriptive studies**

Out of all diseases, cancers localized in various sites of gastrointestinal tract pose the most serious problems in terms of their frequency and consequences for
the health of population (Tables 1 and 2). Descriptive studies on the geographical distribution of cancer in Poland have been conducted in our country since several decades.

F. Staszewski (1) carried out the first descriptive cancer study in 1967, where he presented age-standardized mortality rates in various regions of Poland by gender and area of residence (urban/rural). The largest and most comprehensive work on the geography of cancer in Poland was his monograph published in 1979 entitled "The regional differences in cancer mortality in Poland, 1970-1974" (2). At present, the descriptive studies in the field of cancer epidemiology are

**Table 1. Mortality due to cancer of gastrointestinal tract in Poland (1998)**

<table>
<thead>
<tr>
<th>Cancer</th>
<th>Number of deaths</th>
<th>% of total cancers</th>
<th>Rate/100.000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Esophagus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>994</td>
<td>2.44</td>
<td>5.35</td>
</tr>
<tr>
<td>F</td>
<td>230</td>
<td>0.79</td>
<td>1.18</td>
</tr>
<tr>
<td>Stomach cancer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>4723</td>
<td>11.61</td>
<td>25.42</td>
</tr>
<tr>
<td>F</td>
<td>2567</td>
<td>8.79</td>
<td>13.13</td>
</tr>
<tr>
<td>Colon/Rectum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>3114</td>
<td>7.66</td>
<td>16.76</td>
</tr>
<tr>
<td>F</td>
<td>3195</td>
<td>10.94</td>
<td>16.35</td>
</tr>
<tr>
<td>Liver</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>1237</td>
<td>3.04</td>
<td>6.66</td>
</tr>
<tr>
<td>F</td>
<td>1214</td>
<td>4.16</td>
<td>6.22</td>
</tr>
<tr>
<td>Pancreas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>1685</td>
<td>4.14</td>
<td>9.07</td>
</tr>
<tr>
<td>F</td>
<td>1544</td>
<td>5.29</td>
<td>7.90</td>
</tr>
</tbody>
</table>

**Table 2. Incidence of cancer in gastrointestinal tract in Poland (1998)**

<table>
<thead>
<tr>
<th>Cancer</th>
<th>Number of new cases</th>
<th>Crude rate</th>
<th>Age-standard. rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Esophagus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>1085</td>
<td>5.84</td>
<td>5.42</td>
</tr>
<tr>
<td>F</td>
<td>216</td>
<td>1.10</td>
<td>0.75</td>
</tr>
<tr>
<td>Stomach cancer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>5309</td>
<td>28.58</td>
<td>26.14</td>
</tr>
<tr>
<td>F</td>
<td>2996</td>
<td>15.23</td>
<td>10.37</td>
</tr>
<tr>
<td>Colon/rectum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>4601</td>
<td>24.76</td>
<td>22.69</td>
</tr>
<tr>
<td>F</td>
<td>4725</td>
<td>24.18</td>
<td>16.78</td>
</tr>
<tr>
<td>Liver</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>1147</td>
<td>6.18</td>
<td>5.62</td>
</tr>
<tr>
<td>F</td>
<td>1063</td>
<td>5.44</td>
<td>3.58</td>
</tr>
<tr>
<td>Pancreas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>1918</td>
<td>10.32</td>
<td>9.46</td>
</tr>
<tr>
<td>F</td>
<td>1496</td>
<td>7.66</td>
<td>5.14</td>
</tr>
</tbody>
</table>
continued by the Institute of Oncology in Warsaw, which periodically publishes reports on the incidence and mortality from various cancer sites according to their geographical distributions (3, 4).

Cancer of the esophagus in 1998 caused 2.5% of the cancer-related deaths in men and 0.8% in women and was found to occur much more frequent in men than in women. The population of women has shown declining mortality rates over the recent 30 years, while the population of men experienced a certain decline in the past but the rates began to grow significantly again in the early 1980s. In the past and at the late 1980s, Poland was the country of the highest stomach cancer risk in Europe, which might be related to dietary habits. In 1998 cancer of the stomach caused 12.4% of cancer-related deaths in men and 9.0% in women. However, over the last three decades the stomach cancer mortality trends showed a steady decline in both sexes. Nevertheless, cancer of the stomach is at present the third-leading cancer localization in males and females. Cancer of the colon/rectum caused 7.7% of all the cancer-related deaths in men and 10.9% in women and occurred with about the same frequency in men and women. Cancer of the liver also occurred with the same frequency in women and men. At present, this cancer site was responsible for 3.4% of deaths in men and 4.2% of deaths among women. Cancer of the pancreas caused 4.1% of all cancer-related deaths in men and 5.3% in women.

Fig. 2. The frequency of medical diagnosis of peptic ulcer by smoking habits in adult men and women in Poland
**Epidemiologic analytical studies**

Since 1970 analytical epidemiologic studies aiming at explaining the natural course of various diseases within gastrointestinal tract started to produce interesting results. The first study in this field was the case-control study on the occurrence of peptic ulcer and tobacco smoking performed in 1974 (5). The study has been carried out in the large representative sample, chosen at random from the inhabitants of rural area in central Poland. The study provided one of the first epidemiologic evidence on the harmful effect of tobacco smoking in the etiology or peptic ulcers. It was demonstrated that the relative risk of peptic ulcer in males was about 5 times higher among present smokers or ex-smokers than among non-smokers. However, the relationship was not so clear in females probably due to the small number of smoking women, lower number of cigarettes smoked per day and significantly shorter period of smoking (Fig. 2). If the tobacco-smoking were important in the etiology or gastric ulcers, then a relationship between the frequency of the disease occurrence and number of cigarettes smoked, length of smoking habit or age at starting regular smoking should be expected. In fact, among the factors mentioned above, length of smoking was shown to be of greatest importance.

**Nutrition and stomach cancer**

As mentioned earlier, stomach cancer is one of the most important health problems in Poland. As the survival rate of stomach cancer is low and the early detection of stomach cancer by gastroscopy is expensive, the identification of population risk groups for primary prevention programs is of great importance. There is a good body of evidence that lifestyle and environment are risk factors for the development of stomach cancer. Worldwide, suspected risk factors for stomach cancer include a low intake of fresh fruit and raw vegetables and high intake of salt and processed or otherwise treated meat and fish products (6 - 14).

The first Polish study on nutrition and stomach cancer was conducted in 1980-81 in Krakow (15). One hundred and ten cases from a surgical clinic were matched by age and sex to the same number of controls from the same hospital. After adjusting for residency, smoking habit and various food items, cases and hospital controls showed significant difference in consumption of fruits (RR rarely vs. daily: 3.24; 95% CI: 1.56-6.77), joint consumption of vegetables, salads and fruits (RR low vs. high: 4.23; 95% CI: 1.41-12.63), and consumption of protein-containing foods (RR low vs. high: 0.23; 95% CI 0.08-0.61). Consumption of strong alcoholic drinks on empty stomach (before breakfast) was associated with an RR of 2.09 (1.04-4.22). The comprehensive presentation of the results of the study has been shown in the Fig. 3.

This first cancer study was followed shortly by a serious of studies on nutrition within the households of stomach cancer patients and on importance of vodka drinking and tobacco smoking. In the framework of a nationwide case-control
study of risk factors for stomach cancer in Poland, a household survey was conducted on food habits at the family level, which were considered as potentially relevant for stomach cancer. The practices of 741 case and 741 control households were compared and relative risks calculated by the unconditional maximum likelihood method. For each household, the person responsible for cooking completed the survey (16). Respondents to the household survey were 35% of the cases and 40% of the controls of the case-control study and otherwise other household members. The study has shown that case households relied more frequently on their own gardens as a major source of vegetables and fruit, and they cooked their vegetables more often than control households. The vegetable and fruit consumption during the summer period per family member was significantly lower in case households compared to control households. The difference in per capita vegetable and fruit consumption between case and control households persisted, but was considerably less pronounced when the consumption of the index person (case or control) was subtracted from the household consumption. The consumption of mainly wholegrain bread showed a relative risk (RR) of 0.18 (95% CI 0.07-0.44) compared with mainly white bread consumption, whereas frequent frying and stewing of meat was associated with an increased risk compared to boiling of meat (RR = 2.06, 95% CI 1.48-2.87). No association with risk was found for long-term refrigerator use or other storage
modalities. This study confirmed previous findings that consumption of raw vegetables and fresh fruit is inversely related to risk for stomach cancer in Poland (Fig. 4). In addition the results demonstrated, that dietary practices such as the modality of cooking the food, preparation of food products and storing conditions were connected with stomach cancer risk. These factors have also been found to influence the risk for stomach cancer in Poland. The main message of this latter study was that the family as a whole is affected by many risk factors for stomach cancer and families in which stomach cancer has occurred should be therefore targeted for preventive measures.

**Tobacco smoking and vodka drinking as risk factors in stomach cancer**

A multicentre hospital-based incident case-control study with 520 male gastric cancer cases aged <75 years and an equal number of age- and sex-matched controls without cancer has been subsequently carried out in Poland to assess potential risks for stomach cancer arising from cigarette smoking and alcohol consumption (17, 18). It was shown that after adjusting for socio-demographic and dietary confounders and vodka drinking, smoking cigarettes had no significant effect on risk. However, the estimated relative risk (RR) increased to 2.27 (95% confidence interval (CI): 0.97-5.28) for intestinal cardia cancer for those who smoked cigarettes without filters. The RR for stomach cancer grew as the frequency and amount of vodka drunk increased as well. People drinking

![Relative risk estimates for stomach cancer by tertiles of average familial consumption of vegetables and fruits in case and control households during the summer period](image)


*Fig. 4.* Relative risk estimates for stomach cancer by tertiles of average familial consumption of vegetables and fruits in case and control households during the summer period
vodka at least once a week had about a threefold higher risk compared to non-drinkers (RR = 3.06, 95% CI: 1.90-4.95). The effect of vodka drinking on risk was particularly strong for non-cardia cancers of the intestinal type. Those who usually drank vodka before breakfast had an elevated risk (RR = 2.98, 95% CI: 1.60-5.53). Cardia and non-cardia cancer showed differences with respect to the interaction between tobacco smoking and vodka drinking. For cancers of the cardia region the risk was low for non-smokers or those who drank small amounts of vodka. The risk for cardia cancer increased considerably for smokers of cigarettes without filters and in those who consumed large amounts of vodka (RR = 3.70, 95% CI: 1.13--12.06). For the non-cardia region a uniform increase of risk could be observed for vodka drinking, regardless of cigarette smoking status. The findings of this study suggested the hypothesis that the effect of tobacco smoking and vodka drinking may be different for cardia cancer compared to the distal cancers (Figs 5-7).

**Helicobacter pylori infection and changes in gastric mucosa**

After the rediscovery of *Helicobacter pylori* in the 1980, the primary importance of these bacteria in the pathogenesis not only of peptic ulcer but also of gastric cancer has become highly probable. Recently, we have received a direct proof from animal experiments that *H. pylori* is actually associated with gastric carcinogenesis as all tumors resulting from oral inoculation of Mongolian

![Relative risk diagram](image-url)

*Fig. 5.* Interactive effects of tobacco smoking (cigarettes with filter vs. cigarettes without filter) and vodka drinking on estimated relative risk for stomach carcinoma in non-cardia region
Fig. 6. Interactive effects of tobacco smoking (cigarettes with filter vs. cigarettes without filter) and vodka drinking on estimated relative risk for stomach carcinoma in cardia.

Relative risk

<table>
<thead>
<tr>
<th>Tobacco smoking habit</th>
<th>Non drinkers</th>
<th>Very rare</th>
<th>More than once a week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never smokers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smokers with filter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smokers without filter</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Fig. 7. Relative risk estimates with 95% confidence intervals for gastric cardia cancer in males by histologic type, due to amount of vodka consumed per occasion.

Relative risk

<table>
<thead>
<tr>
<th>Alcohol</th>
<th>Null</th>
<th>100g</th>
<th>250g</th>
<th>more</th>
<th>Null</th>
<th>100g</th>
<th>250g</th>
<th>more</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carcinoma intestinalis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carcinoma diffusum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Gerbils consisted of well-differentiated intestinal-type epithelium, and their development seemed to be closely related to intestinal metaplasia (19).

Nowadays, substantial evidence shows that infection with *H. pylori* causes chronic active gastritis, which predominantly involves the gastric antrum. The latter may progress to chronic gastritis with various degrees of atrophy and this is a possible background for the development of intestinal metaplasia and consequently dysplasia and gastric carcinoma. Chronic atrophic gastritis along with its accompanying lesion, intestinal metaplasia is the most prevalent precursor of intestinal type gastric carcinoma. These precancerous lesions usually occur many years before the actual onset of most cases of stomach cancer, but the transition process from precursor lesions to gastric carcinoma is not fully understood (21 - 27).

Together with the observations showing the association between *H. pylori* infection and chronic gastritis, data have been published confirming the correlation between the presence of intestinal metaplasia and *H. pylori* in the gastric antral mucosa. This may suggest that the presence of *H. pylori* is implicated not only in gastritis but also in the etiology of antral intestinal metaplasia and *H. pylori* could be assumed as an accelerator of the processes leading to metaplasia. A possible causal relationship between *H. pylori* and intestinal metaplasia is presently under debate. In fact, intestinal metaplasia being considered as a result of consequential stages of progression in inflammation.

![Table showing environmental factors and their relative risk for chronic gastritis and intestinal metaplasia in the antrum](image)

Fig. 8. Environmental factors and their relative risk for chronic gastritis and intestinal metaplasia in the antrum
process might be a product of *H. pylori*-related gastritis. However, Correa (10, 20) proposed that the finding of intestinal metaplasia in gastric biopsies indicate the etiology of gastritis is distinct from that of *H. pylori*. He suggests that intestinal metaplasia is rather a result of exogenous and/or dietary factors like excessive intake of salty foods and nitrates, deficiency in fresh fruits and leafy vegetables than *H. pylori* infection.

Considering the above-mentioned reports, the purpose of other epidemiological study was to assess risk factors for intestinal metaplasia arising from chronic gastritis in a subset of the population that underwent endoscopic examinations due to dyspeptic complains. The specific aim of the study was to establish whether *H. pylori* itself may be responsible for the occurrence of intestinal metaplasia and to which extent the metaplasia may be associated with life style factors such as cigarette smoking, alcohol consumption or dietary habits.

The study was carried out in a sample of 1290 outpatients referred for the gastroenterologic outpatient clinics in 6 university centers in Poland (28, 29). The study methods covered standardized health interviews, endoscopy and histology of gastric antral specimens taken at endoscopy. The interviews performed by trained interviewers sought information on tobacco and alcohol intake, diet, socio-economic status, and other variables. In non-ulcer dyspepsia subjects there was 54.9% *H. pylori* related gastritis and 25.1 % of non-*H. pylori*-related gastritis. The corresponding rates in the group of ulcer dyspepsia were 67.5% and 20.5%. The increased risk of chronic gastritis in antrum was associated with *H. pylori* infection (RR=2.28; 95% CI:1.93 - 2.69), and with gastric peptic ulcer (RR=1.88; 95% CI:1.20 - 2.94). In the non-ulcer dyspepsia the prevalence of metaplasia was

![Fig. 9. Estimated preventive effects (OR, 95%CI) of daily consumption of fresh fruits on the occurrence of antrum metaplasia](image-url)
11.1% and in ulcer-dyspepsia 19.7%. The risk of intestinal metaplasia within antrum depended greatly upon the presence of gastric peptic ulcer (RR=3.85; 95% CI:2.35 - 6.32) and increased with age (RR=1.05; 95% CI:1.04 -1.07), smoking cigarettes currently or in the past (RR=1.42; 95% CI: 1.10 - 1.84), higher frequency of drinking vodka (RR=1.32, 95% CI:1.01 - 1.75) and antral chronic gastritis (RR=1.31; 95% CI:1.00 - 1.70), however, it was inversely related to daily consumption of fresh fruits or vegetables (RR=0.59; 95% CI:0.38 - 0.93). The results of the study suggested that there is no sufficient evidence supporting the hypothesis about an association between H. pylori gastritis and intestinal metaplasia, however, the transition of gastritis to metaplasia depends greatly on life style factors such as cigarette smoking or vodka drinking and is impeded by daily consumption of fresh fruits or vegetables (Figs 8 and 9).

**Colorectal cancer and physical activity**

Although a genetic component in the etiology of colon cancer is well established, wide differences in cancer rates between countries and changes in rates among migrants point to diet and western life style as potentially important factors. The specific dietary factors that may explain most of the variation in rates among countries have yet not been proven, but evidence suggests that diets high in energy, animal fat and low in fiber fruits and vegetables may increase the risk of this cancer (30) (Fig.10).

![Fig. 10. Estimates of adjusted odds ratios and 95% confidence intervals for colorectal cancer by quartile consumption of selected nutrients](image_url)
There are observations that higher physical activity may have the protective effect on the occurrence of colon cancer. However, people who are more physically active may differ from those who are less active in fiber and energy intake or protective micronutrients, and these factors may have an effect on the risk of developing colon cancer. As there were no data on the effects of physical exercise in working hours and in leisure time on colorectal cancer that take into account the protective micronutrients as well, the purpose of the following study was to assess the importance of physical activity performed both in occupational settings and in the leisure times on the risk pattern of colon cancer considering the confounding effects of dietary habits.

The hospital-based case-control study included in total 180 incident cases of colorectal cancer. An equal number of controls, individually matched by gender and age, were chosen from patients with no history of cancer (31, 32). The dietary part of the questionnaire included detailed information on dietary habits relating to the following food groups: cereals, milk, bread, rat used for bread, processed meats and fish, milk products and eggs, fresh fruits (summer/autumn), fresh fruits (winter/spring), meats (beef, park), chicken, kind of fat used for baking and frying, salads and fresh and cooked vegetables, potatoes (mashed/baked), rice or pasta, soups, sweets, baked goods, etc.

Occupational physical activity data were also ascertained during interview and the interviewee and not the interviewer assessed the level. The occupational
activity specific for a given person was defined as the usual type of work performed 5 years prior to illness for the cases and for 5 years prior to interview for controls. Occupational physical activity was divided into three categories: light physical work in sitting or standing position, work done with moderate physical effort, and heavy manual work being performed on most days in a week. In addition, number of hours spent daily watching TV was used to classify the way the patients spent their leisure time. Recreation activity was divided into three levels depending on the number of TV watching hours: low physical activity (sedentary) 2: 2 hours spent daily on watching TV, moderately sedentary (1.14- < 2 hours), and active < 1.14 hours/day). The cut-off points were defined by the tertiles in the control group (Fig.11).

The results of the colon cancer study have shown that the adjusted risk of colorectal cancer was reduced by half in subjects being active in leisure time (RR 0.45, 95% CI 0.24-0.84). The effect of occupational physical activity was of about the same order of magnitude in terms of risk reduction (RR 0.61, 95% CI 0.29-1.29) and both activities combined acted as independent protective factors. The protective effect of healthy nutrition appeared to be independent from that attributed to physical effort (Fig.12). The relation between physical activity and the risk of colorectal cancer is currently a very 'hot topic' because of its potential importance in cancer prevention. Several case-control and cohort studies have studied the contributions of lifestyle factors beside dietary habits, with the focus

![Graph showing Odds ratios from multiple logistic regression of colorectal cancer by nutritional intake score (NIS) and leisure time physical activity](image-url)
on physical activity. Increased risk of colon cancer among those employed in sedentary occupations and performing jobs with a small amount of physical effort has been demonstrated (33 - 42). If physical activity is really protective then we should have a good plausible mechanism to explain it. However it is important to note, we need to know more about the biologic meaning of this relationship to be able to plan any prevention strategies. The hypothesized mechanisms for the protective effect of physical activity on colon cancer is that it increases the velocity with which food residues pass through colon, it has an effect on body mass index and body fat composition, and it induces changes in serum cholesterol and bile acid metabolism. It is also probable that prostaglandin engendered by exercise stimulate colon peristalsis.

REFERENCES


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