

## THE INCIDENCE OF CHRONIC PEPTIC ULCER FOUND AT NECROPSY

A STUDY OF 20,000 EXAMINATIONS PERFORMED IN LEEDS IN 1930-49  
AND IN ENGLAND AND SCOTLAND IN 1956

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In this study the frequency of gastric, duodenal, and stomal ulcer has been determined in a survey at necropsy. This survey is likely to be much more accurate than those previously reported, as it has been a "forward planned" one and conducted by a group of men interested in this subject. In retrospective studies it is always impossible to know how carefully a particular point has been checked. It has been concluded from this study that the best estimate of the incidence of ulcer in the population as a whole can be made from the frequency of ulcers found in patients dying from causes other than peptic ulcer. The incidence of such active ulcers accords closely with clinical experience in life.

### THE LEEDS SURVEY 1930-49

Estimates of the incidence at necropsy of peptic ulcer are open to criticism on many grounds: pathologically, because the standard of examination must vary from hospital to hospital and from pathologist to pathologist as the pathological types and sites of ulcer have not been clearly distinguished, and duodenal scars are either missed or not thought worthy of record. Frequently, statistical principles are ignored in that all lesions from varying age groups are expressed as a single percentage with no regard for the age distribution of the ulcers found or the necropsy population at risk. The necropsy population may not give a true impression of hospital deaths because a varying fraction of the hospital deaths in different surveys is pathologically examined. The hospital population itself must be highly selected, reflecting the population served by the hospital, and the specialized interests and skill of the hospital staff. The reader is referred to the excellent critical appraisals of necropsy statistics published in 1950 by Ivy, Grossman, and Bachrach and by Levij (1959).

The many fallacies inherent in this type of analysis have discouraged pathologists from investigating further the incidence of ulcer; indeed a leading article published in the *Lancet* suggested that "the time and money spent on this type of examination could well be utilized in more profitable

pastimes". However, there exists in many quarters a demand for estimates of ulcer frequency, and with notable exceptions incidence rates based on mortality statistics, clinical studies, food rationing figures, and social and industrial surveys limited by inadequate diagnostic methods are subject to as many limitations as are necropsy data. Necropsy statistics can be likened to corsets as undesirable, uncomfortable, frequently giving a fallacious impression of truth yet in special selected circumstances forming a basis for deduction, and at all times much sought after.

The data, presented in this paper with full awareness of their inadequacies, are produced because information has been collected from two sources, both unique, which to some extent reduce the defects in this type of investigation. They comprise first, the findings of one internationally acknowledged expert on ulcer incidence in one town, and, secondly, the findings of many pathologists in nine towns in England and Scotland in a forward-planned, concurrent investigation where particular care was taken to describe all ulcer lesions at hospital necropsies performed in 1956.

Over a 20-year period, between 1930 and 1949, necropsies performed in the Pathology Department of the University of Leeds have been analysed retrospectively by one observer. They were all performed under the close personal supervision of

the late Professor Matthew Stewart, whose contributions to the pathological study of peptic ulcer are well known. Stewart personally examined a large proportion of stomachs removed at necropsy, meticulously describing the ulcer lesions found, and inspiring in his staff a vigorous interest in the ulcer. The high standard of correlated clinical and pathological reports maintained in the department, the minute descriptions of the ulcers, particularly of ulcer scars, make this material almost unique for this type of survey. In Leeds a large proportion of the bodies of patients dying in hospital are examined at necropsy, 88% being examined in the 20-year period surveyed. The records will therefore indicate the pattern of hospital deaths during that time.

Secondly, a forward-planned, concurrent investigation of the incidence of ulcers at 11 teaching and seven non-teaching hospitals in London, Oxford, Bristol, Birmingham, Manchester, Leeds, York, Newcastle, and Glasgow was undertaken in 1956, so that it has been possible to estimate the national and regional frequency of ulcer. The data collected in both surveys formed the basis of a report to the conference on the geographical pathology of peptic ulcer held in Paris in 1957.

#### METHOD OF RECORDING AND ANALYSIS

The data were recorded on a proforma, listing age, sex, positive pathological findings, and the presence or absence of peptic ulcer. Deaths caused by ulcers and ulcers found incidentally were first distinguished, and the pathological type of ulcer specified as a chronic active ulcer, a chronic inactive ulcer or scar, an acute, or a subacute ulcer; acute erosions were excluded and chronic ulcer lesions were preferentially recorded in viscera in which several lesions were present. The site was indicated as gastric, duodenal, combined gastric and duodenal, stomal and oesophageal, and, finally, complications associated with the ulcer such as haemorrhage, perforation, cicatricial deformity, malignant change, and deaths following gastric surgery were enumerated.

Where a previous gastrectomy was discovered to have been performed an attempt was made to trace from the clinical records the site and type of ulcer for which the operation had been undertaken, but was not always possible, in which case the examination was included as a chronic ulcer unrelated to death.

In both surveys examinations which were incomplete or inconclusive were excluded, and cases of gastric carcinoma were omitted as the lesion frequently prevented adequate examination of the

stomach and duodenum. The information recorded on a proforma was then transferred to a Powers-Samas punch card, double checked by independent operators and machine sorted.

Ulcer incidence was calculated as chronic active, chronic inactive, and combined inactive and active lesions, unrelated to and related to death, as a percentage incidence of the total necropsy population at risk in each age group. Adding these two groups gives the total incidence of chronic ulcer lesions in the survey. Seven age groups are included as follows: 0-24 years, 25-34 years, 35-44 years, 45-54 years, 55-64 years, 65-74 years, and over 75 years. The overall incidence of ulcer is reluctantly given for comparison with other surveys. It should be stressed, however, that this figure is almost valueless, depending as it does on the age distribution of the necropsy population at risk.

Probably the best estimate of the prevalence of ulcer in the general population is obtained by completely excluding all the ulcer deaths due to acute, subacute, or chronic ulcer from the necropsy population under consideration, and recording the incidence of chronic ulcer lesions found by chance in people dying in hospital for reasons other than ulcer. These are recorded as "incidental ulcer excluding ulcer deaths".

#### NECROPSY POPULATION AT RISK

Between 1930 and 1949, 15,130 deaths occurred at the Leeds General Infirmary and 13,314 necropsies were performed in the Pathological Department of the University of Leeds representing 87.9% of the hospital deaths. After 206 records (1.5%) had been rejected as inadequate, incomplete, or inconclusive, and 468 deaths from gastric carcinoma had been excluded, 12,640 records remained for analysis, representing 83.5% of the hospital deaths in that period and 94.9% of the necropsies performed. Seven thousand, seven hundred and twenty-two males and 4,918 females are included.

In the 1956 national survey, 7,290 records were submitted for analysis in Leeds, 19 were rejected as incomplete, inconclusive, or inadequate (0.3%), and 184 patients with gastric carcinoma were excluded, leaving 7,087 records for analysis comprising 4,151 males and 2,936 females.

Wide variation in the age distribution in the population at risk was apparent between hospitals, between towns, and between the 1956 and Leeds survey (Table I). These differences reflected varying obstetric, casualty, and geriatric facilities in the hospitals concerned and improved methods of treatment of acute infections and accidents, together with a reduced operative mortality in the two decades

TABLE I  
PERCENTAGE AGE DISTRIBUTION OF NECROPSY POPULATIONS STUDIED

Sex	Survey	-25 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years	75+ years	Total
Males	Leeds, 1930-49	25.4	7.3	9.5	15.4	21.3	16.3	5.8	7,722
	National, 1956	14.3	3.3	6.2	14.0	24.1	24.8	13.3	4,151
Females	Leeds, 1930-49	27.9	7.2	9.6	15.1	19.4	15.5	5.4	4,918
	National, 1956	14.4	4.1	6.4	12.1	20.4	23.8	18.9	2,946

between the two surveys. Age distribution differences, neglected in so many of the published reports, must be allowed for if any single overall figure for ulcer in two populations is being compared. The percentage age distribution of the two populations studied is shown in Table I.

COMPARISON OF OCCURRENCE OF ULCERS  
IN THE TWO SURVEYS

The relative overall frequency of the lesions is compared in Table II. In this and in all succeeding tables, the ulcer incidence in the national survey has been corrected for variation in age distribution in

TABLE II  
COMPARISON OF OVERALL INCIDENCE OF ULCER IN TWO SURVEYS

	Males			Females		
	Leeds 1930-49	National 1956		Leeds 1930-49	National 1956	
Necropsy population	7,722	4,151		4,918	2,936	
	Observed	Observed	Corrected	Observed	Observed	Corrected
Total ulcer, all types	1,628 (21.1%)	630 (15.2%)	531.9 (12.8%)	541 (11%)	283 (9.7%)	233.5 (7.9%)
Total chronic ulcer	1,415 (18.4%)	518 (12.5%)	433 (10.4%)	433 (9.5%)	184 (6.3%)	144.8 (4.9%)
Chronic active ulcer	761 (9.9%)	302 (7.3%)	251.7 (5.7%)	166 (3.4%)	108 (3.7%)	80.5 (2.7%)
Chronic inactive ulcer	654 (8.5%)	180 (4.3%)	148.1 (3.6%)	267 (6.2%)	63 (2.2%)	45.0 (1.5%)
Acute and subacute ulcer	213 (2.7%)	112 (2.7%)	98.9 (2.4%)	108 (2.2%)	99 (3.4%)	88.7 (3.0%)

TABLE III  
STATISTICAL COMPARISON OF OVERALL ULCER INCIDENCE IN THE TWO SURVEYS

	Males			Females		
	Leeds 1930-49	Corrected National 1956	$\chi^2$ n = 1	Leeds 1930-49	Corrected National 1956	$\chi^2$ n = 1
Necropsy population	7,722	4,151	—	4,918	2,936	—
Total chronic ulcer						
Active	761 (9.9)†	252 (6.1)	$\chi^2 = 45.176^*$ P < 0.001	166 (3.4)	87 (2.9)	$\chi^2 = 1.078$ P = 0.3
Inactive	654 (8.5)	148 (3.6)	$\chi^2 = 96.902^*$ P < 0.001	267 (6.2)	48 (1.7)	$\chi^2 = 66.390^*$ P = < 0.001
Chronic duodenal ulcer						
Active	425 (5.5)	137 (3.3)	$\chi^2 = 28.147^*$ P < 0.001	72 (1.5)	31 (1.1)	$\chi^2 = 2.641$ P < 0.2
Inactive	472 (6.1)	83 (2.0)	$\chi^2 = 99.640^*$ P < 0.001	160 (3.3)	29 (1.0)	$\chi^2 = 16.425^*$ P < 0.001
Chronic gastric ulcer						
Active	186 (2.4)	93 (2.2)	$\chi^2 = 0.393$ P < 0.7	65 (1.3)	39 (1.3)	$\chi^2 = 0.0001$ P < 0.99
Inactive	119 (1.5)	59 (1.2)	$\chi^2 = 0.222$ P < 0.7	80 (1.6)	16 (0.5)	$\chi^2 = 17.778^*$ P < 0.001
Combined ulcer						
Active	113 (1.5)	10 (0.2)	$\chi^2 = 39.937^*$ P < 0.001	27 (0.6)	4 (0.1)	$\chi^2 = 8.698$ P < 0.01
Inactive	61 (0.8)	4 (0.1)	$\chi^2 = 24.291^*$ P < 0.001	26 (0.5)	0.4 (0.01)	$\chi^2 = 16.103^*$ P < 0.001

\* Results showing a significantly increased incidence. † Percentages increase in brackets.

the necropsy population examined to be directly comparable with the Leeds study. A similar overall incidence of acute and subacute ulcers was demonstrated in the 321 ulcers found in the Leeds survey and the 211 ulcers found in the national survey (Leeds, males 2.7%, females 2.2%; national, males 2.4%, females 3.0%). Chronic ulcer lesions, in contrast, are approximately twice as common in the Leeds figures compared with the national

figures, in males 18.4% to 10.4% and in females 9.5% to 4.9%. The differences are most apparent in the incidence of inactive lesions, males 8.5% to 3.6% and females 6.2% to 1.5%, the gap in incidence narrowing when active lesions are considered, males 9.9% to 5.7% and females 3.4% to 2.7%. This difference will be studied in more detail later.

Fallacies in the comparison of necropsy statistics done at different times by different pathologists is

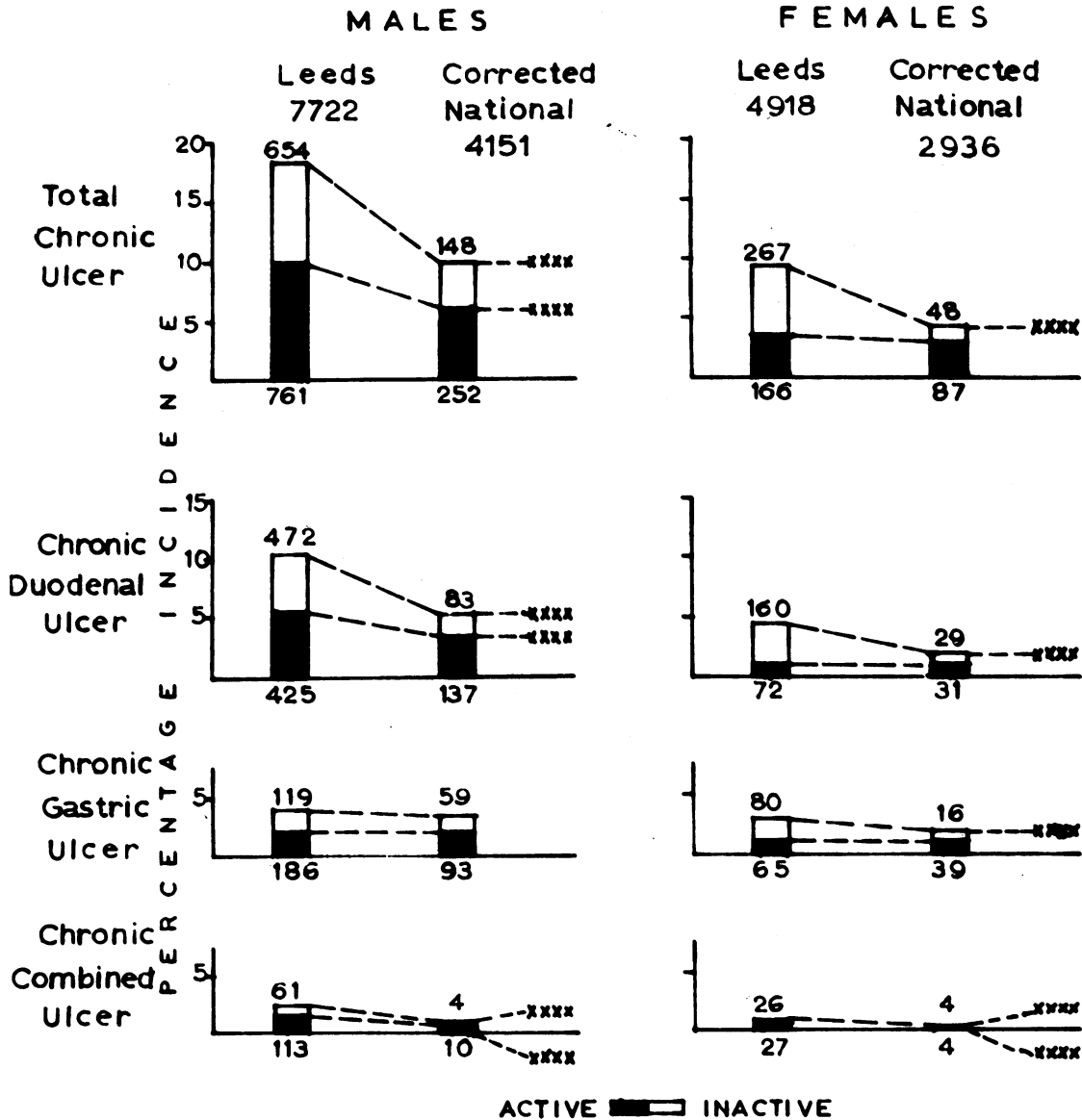


FIG. 1.—The overall incidence of ulcer in the Leeds and national surveys.  $P = < 0.05^* < 0.02^{**} < 0.01^{***} < 0.001^{****}$

well illustrated when the overall ulcer incidence in the Leeds figures is compared with the overall national figures in Table III, which shows that a highly significant increased incidence of chronic peptic ulcer is present in many of the Leeds figures compared with the corrected national figures (Fig. 1). In men, total, duodenal, combined, active and inactive lesions show highly significant differences in the two series, which are grossest for inactive duodenal lesions (6.1% to 2.0%) and mainly contribute to the significantly increased incidence of inactive lesions when all sites are considered together (8.5% to 3.6%). The occurrence of active gastric ulcer (2.4% and 2.2%) and gastric ulcer scars (1.5% and 1.2%) does not differ in the two series. In the combined ulcer lesions, where the recognition of minimal inactive duodenal lesions becomes important, significant differences are again observed, both ulcers and scars being approximately eight times more common in the Leeds series. In women again a highly significant increased incidence of ulcer scars is present for all types of ulcer which contribute to the total difference (6.2% as compared with 1.7%). The incidence of all types of active ulcer does not differ in the two series save for combined lesions, where active lesions show a sixfold and inactive lesions a 50-fold increase.

It at once emerges that inactive lesions have been found significantly more commonly in the Leeds survey, particularly duodenal scars and the combined gastric and duodenal lesions, gastric scars, for some reason, showing only an increased incidence in women. The possibility that the incidence of ulcer has declined in the eight years between the two surveys receives little clinical support. Evidence has been produced (Watkinson, 1958) suggesting an increased regional incidence in northern as compared with southern cities but this cannot wholly explain the differences. The difference must rest in the high standard of examination and the almost fanatical care with which duodenal scars were sought out and reported under Professor Stewart's direction in the Pathology Department of the University of Leeds. Therefore this series should give the most accurate appraisal of incidence.

The differences observed in active ulcers are less easily explained. The total occurrence in men of active ulcers is increased to a highly significant degree (6.1% to 9.9%), mainly contributed to by increases in duodenal and combined lesions. In women, however, there is no significant change in total (2.9% to 3.4%) or in duodenal ulcers (1.1% to 1.5%), combined lesions, however, showing a sixfold increase. The prevalence of active gastric ulcer in both men (2.4% and 2.2%) and in women

(1.3% and 1.5%) agrees closely in the two series. Had observer error been wholly to blame one would not have expected to have found a significantly increased incidence of active duodenal ulcers in men and not in women, nor a significant increase in gastric scars in women and not in men, and these may well represent true regional variations.

The wide discrepancies in the occurrence of ulcers in two surveys done under optimal conditions emphasize that comparison with other necropsy studies would be valueless, and for this reason a factual statement on ulcer incidence in the circumstances in which each survey was done will be made and only passing reference to its incidence in other surveys will be attempted. The differences which have emerged show that even though special care is taken to identify and report ulcer lesions, the standard of examination cannot match up to that of an enthusiast in his field. It may be that the incidence in Stewart's hands was too high and that the true frequency lies somewhere between the two groups of data presented.

#### INCIDENCE OF CHRONIC PEPTIC ULCER IN THE LEEDS SURVEY 1930-49\*

The incidence of the various types of peptic ulcer causing and unrelated to death in the Leeds survey is shown in Figs. 2-6.

**ALL PEPTIC ULCERS.**—The occurrence of all peptic ulcer lesions found incidentally and causing death in men and in women is illustrated in Fig. 2.

The 1,415 ulcer lesions described in men were demonstrated in 18.4% of necropsy examinations, being active ulcers and scars in almost similar proportions, 9.9% and 8.5% respectively. These ulcers had caused 6.8% of the necropsy deaths and were found by chance in 11.5% of the examinations performed, scars being found incidentally twice as commonly as were active ulcers, 8.0% to 3.5%.

Ulcers caused most deaths in men between the ages of 45 and 54 years, and accounted for 13% of the necropsy deaths in that age group. The frequency declined in preceding and succeeding decades to 0.6% below 25 years and 2.7% above 75 years, and remained between 6.3% and 10.9% in the remaining age groups.

Ulcers were found by chance most commonly between the ages of 45 and 54 years, where approximately one in six men showed ulcer lesions. Ulcers occurred with almost uniform frequency in all age groups after 35 years, the incidence varying between

\* Copies of tables enumerating precise percentages of ulcer frequency have been deposited at the libraries of the Royal Society of Medicine and the British Medical Association in London from which this information can be obtained. Alternatively the author may be approached directly.

13.0% and 16.6%. Active and inactive lesions followed similar distributions, active ulcers being demonstrated fortuitously in approximately one in 20 men above the age of 45 years. The varying age distribution of the ulcer deaths and ulcers found incidentally must represent selection in the type of case admitted to hospital rather than any lessening of ulcer mortality with age.

The perhaps unwise combination of ulcers causing and unrelated to deaths serves only to emphasize the frequency of peptic ulcer in middle-aged men where between one in three (29.2%) and one in four (24.1%) showed ulcer lesions.

When ulcer deaths are excluded from consideration ulcers were found incidentally in approximately one in seven men (14.2%) dying in hospital in Leeds from causes other than ulcer, one in 25 (4.3%) having an active ulcer at death. The age distribution of the ulcers found incidentally in men and women is shown in Fig. 3. Ulcers are found by chance in one in every five or six middle-aged or elderly men dying in hospital in Leeds exclusive of ulcer deaths (15.5% to 23.0%), approximately one in every 17 having active ulcers (4.1% to 7.1%).

The 433 ulcer lesions demonstrated in women

(Fig. 2) occurred with only half the overall frequency of those in men, namely in 9.5% of post-mortem examinations, 91 accounted for 2.6% of the necropsy deaths, while 342 were found incidentally in 6.9% of the examinations. Ulcer scars were found twice as frequently as were active ulcers (6.2% to 3.4%). Fig. 2, which illustrates the age distribution of the ulcers in women, demonstrates, the tendency, particularly for ulcer deaths and incidental active ulcers, to increase in frequency with advancing age. Ulcer scars found by chance doubled in frequency, from 3.3% to 7.4%, between the ages of 35 and 45 years. Ulcers caused most deaths (3.7%), and were found most commonly fortuitously between the ages of 65 and 74 years when approximately one in eight women were affected. The best estimate of ulcer frequency in the general population after ulcer deaths had been excluded would suggest that approximately one in 10 women between the ages of 35 and 44 years had suffered from peptic ulcer, one in 50 having active ulcers. This figure increased in elderly women to one in seven, of whom half had active lesions (Fig. 3).

When the relative sex incidence of peptic ulcers is studied ulcers caused roughly two and a half

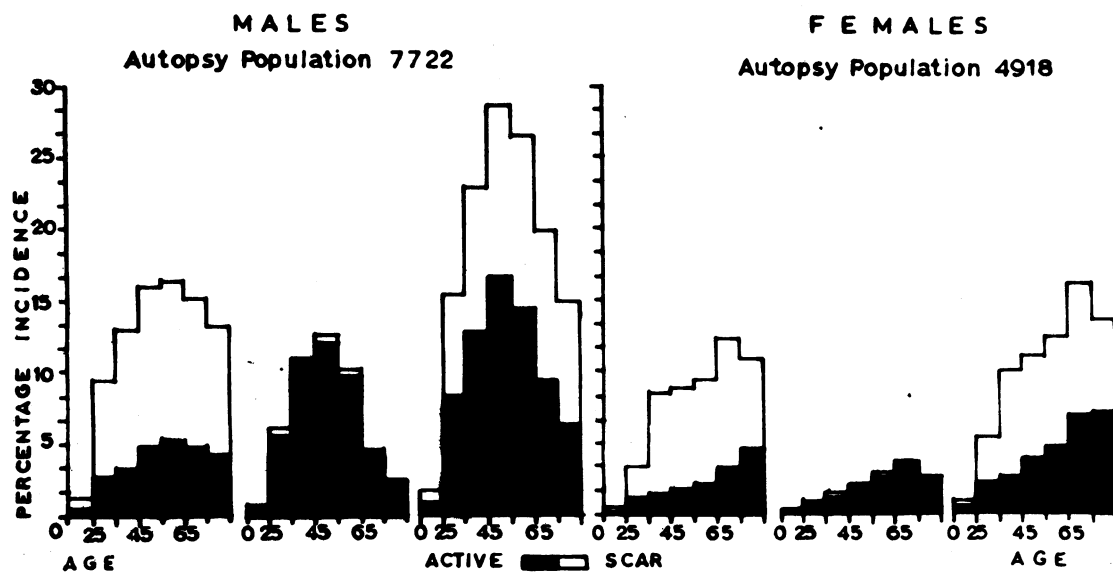


FIG. 2.—The observed percentage frequency of all types of chronic ulcer at necropsy in Leeds between 1930 and 1949.

	Males			Females		
	Ulcers Unrelated	Ulcer Deaths	Total Ulcers	Ulcers Unrelated	Ulcer Deaths	Total Ulcers
Active Scars	271 (3.5%) 619 (8.0%)	490 (6.3%) 35 (0.4%)	761 (9.9%) 654 (8.5%)	79 (1.6%) 263 (5.4%)	87 (1.8%) 4 (0.1%)	166 (3.4%) 267 (6.2%)
Total	890 (11.5%)	525 (6.8%)	1,415 (18.4%)	342 (6.9%)	91 (2.6%)	433 (9.5%)

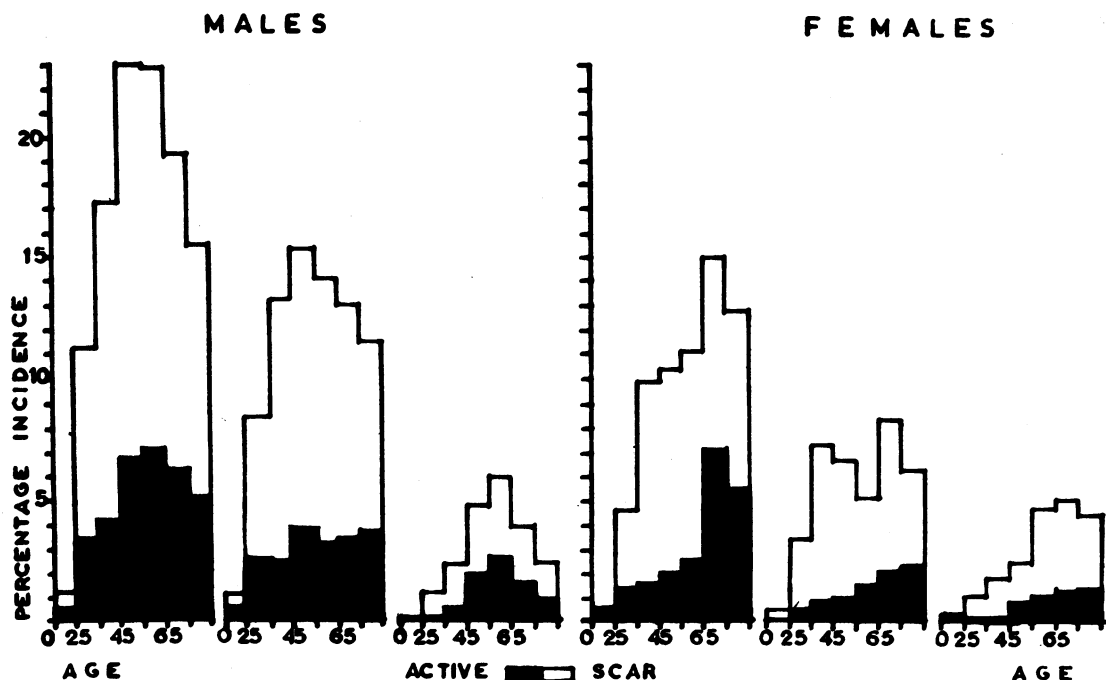


FIG. 3.—The best estimate of ulcer frequency in the general population in Leeds, namely the incidence of ulcers after the highly selected group of ulcer deaths had been excluded from consideration.

	Males			Females		
	Total	Duodenal Ulcer	Gastric Ulcer	Total	Duodenal Ulcer	Gastric Ulcer
Active Scars	271 (4.3%) 619 (9.9%)	153 (2.4%) 451 (7.2%)	72 (1.2%) 107 (1.7%)	79 (1.8%) 263 (5.9%)	37 (0.83%) 158 (3.5%)	26 (0.58%) 79 (1.8%)
Total	890 (14.2%)	604 (9.6%)	179 (2.9%)	342 (7.7%)	195 (4.4%)	105 (2.3%)

times more ulcer deaths in men than in women, a ratio of 2.63 to 1. Ulcer deaths occurred between six and eight times more commonly in young and middle-aged men than in women of the same age groups. Ulcer deaths increased sufficiently in frequency in elderly women so as to eliminate the sex difference by the age of 65 years.

Ulcer scars were found by chance one and a half times more often in men as compared with women, while incidental active ulcers were discovered twice as often. Again the male preponderance is most marked in the young and middle-aged, and lessened above the age of 65 where ulcer lesions were found with almost similar frequency.

**CHRONIC DUODENAL ULCER.**—The overall and age distribution of the 897 chronic duodenal ulcer lesions found in men and the 232 ulcers in women is shown in Fig. 4. In men chronic duodenal ulcer lesions were found in one in nine (11.6%) of the necropsies performed, caused one in 25 (3.8%)

of the necropsy deaths, and were found incidentally in one in 12 necropsies (7.8%). Three times as many ulcer scars were found by chance as were active ulcers, relative frequencies being 5.8% to 2.0%, a similar ratio being maintained when ulcer deaths had been excluded, namely 7.2% to 2.4%. The 640 ulcer lesions, found incidentally after the exclusion of ulcer deaths, suggested that slightly more than one in 10 men (9.6%) in the hospital population studied had suffered from chronic duodenal ulcer.

Duodenal ulcers caused approximately one in 16 of the hospital deaths in men between the ages of 35 and 64 years with almost similar frequency in each of the decades included. Deaths due to this cause were less common in the young, 0.5% and 4.0%, and in the elderly, 2.4% and 1.1%.

Ulcers found by chance in men followed a distinctive age distribution, rapidly reaching a frequency of approximately one in 10 necropsies by the age of 35 years and showing a similar frequency with

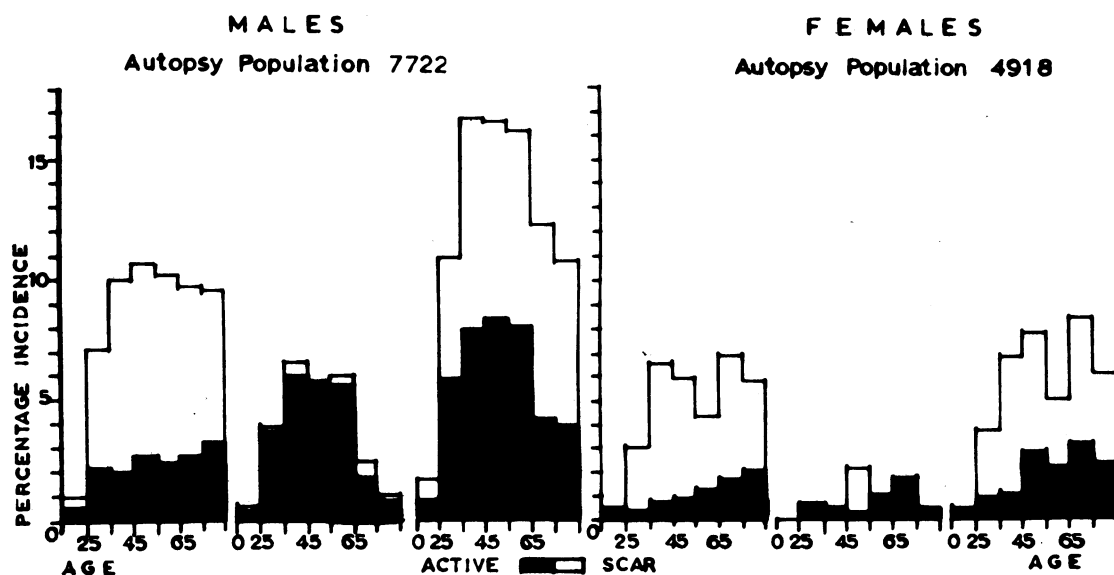


FIG. 4.—The incidence of chronic duodenal ulcer lesions discovered at necropsy in Leeds between 1939 and 1949.

	Males			Females		
	Ulcers Unrelated	Ulcer Deaths	Total Ulcers	Ulcers Unrelated	Ulcer Deaths	Total Ulcers
Active Scars	153 (1.9%) 451 (5.8%)	272 (3.5%) 21 (0.3%)	425 (5.5%) 472 (6.1%)	37 (0.7%) 158 (3.2%)	35 (0.7%) 2 (0.4%)	72 (1.5%) 160 (3.3%)
Total	604 (7.7%)	293 (3.8%)	897 (11.6%)	195 (3.9%)	37 (1.1%)	232 (4.8%)

advancing age in all subsequent decades, active ulcers being found in approximately 3% and ulcer scars in 8% of the necropsy population. Combination of the data revealed that approximately one in six men, in middle age, had suffered from or died from duodenal ulcers. When ulcer deaths had been excluded to give the best possible estimate of ulcer frequency (Fig. 3), this figure fell to one in seven (15.3%) in middle age, and to one in nine (11.5%) in the elderly.

Chronic duodenal ulcers were found less often in women (Fig. 4), being demonstrated incidentally in one in 25 examinations. They accounted for one in 75 of female hospital deaths occurring with a combined overall frequency of one in 20 necropsies. Again, approximately four times as many ulcer scars were demonstrated as were active ulcers at 3.2% to 0.8%. When ulcer deaths had been excluded, it was estimated that approximately one in 23 women had suffered in their lives from ulcer, rather less than one in 100 (0.8%), having active ulcers at death. When age incidence was considered (Fig. 4) little reliance can be placed on the small number of deaths due to ulcer in women save that they occurred more commonly after the

menopause. Of the 195 ulcers found by chance, a tendency for active ulcers to become more common with advancing age was demonstrated, ulcer lesions increasing from 0.3% at 25 to 1.9% over the age of 75 years. Ulcer scars, as in men, reached a peak frequency at the age of 35 years where approximately one in 16 showed lesions, the incidence being of a similar order subsequently at 3.1% to 5.3%. When the few ulcer deaths had been excluded (Fig. 3), active duodenal ulcers again showed a progressively increasing frequency with advancing age, increasing from 0.3% in the second decade to 2.2% in the seventh. The figures suggest that between one in 20 (4.9%) and one in 12 (8.2%) of middle-aged and elderly women have suffered from duodenal ulcer.

Duodenal ulcers caused approximately five times more deaths in men than in women and were found incidentally twice as often. This male dominance was most marked below the age of 45 years where approximately 20 times more deaths from ulcer occurred in men, the gap narrowing with advancing age to one and a half to one above the age of 65 years. Incidental ulcers were demonstrated between two and three times as commonly in men as in women in most age groups, differences being



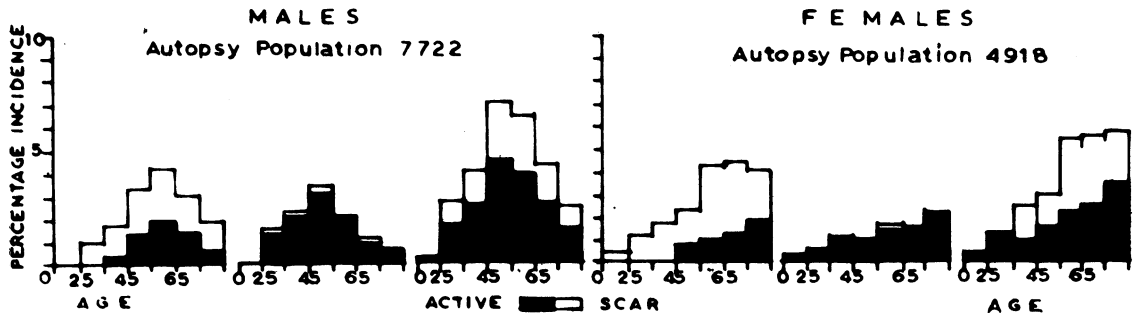


FIG. 5.—Chronic gastric ulcer lesions demonstrated in the Leeds survey.

	Males			Females		
	Ulcers Unrelated	Ulcer Deaths	Total Ulcers	Ulcers Unrelated	Ulcer Deaths	Total Ulcers
Active Scars	72 (0.9%) 107 (1.4%)	114 (1.5%) 12 (0.2%)	186 (2.4%) 119 (1.5%)	26 (0.5%) 79 (1.6%)	39 (0.79%) 1 (0.2%)	65 (1.3%) 80 (1.6%)
Total	179 (2.3%)	126 (1.7%)	305 (3.9%)	105 (2.1%)	40 (0.81%)	145 (2.9%)

most marked in the young, 2.9 : 1, and least marked in the elderly, 1.6 : 1.

**CHRONIC GASTRIC ULCER.**—The overall incidence and age distribution of the 305 gastric ulcer lesions demonstrated in men, together with the 145 lesions in women, is shown in Fig. 5.

Gastric ulcers or scars were demonstrated in approximately one in 25 of necropsies in males (3.9%) of which about one in 40 (2.4%) had active lesions. Gastric ulcers had caused 126 deaths (1.6%) and had been found incidentally in one in 40 necropsies, rather fewer than one in 100 having active ulcers. Excluding ulcer deaths, I would estimate that approximately one in 33 men (2.9%) in a hospital population have suffered from gastric ulcer, approximately one in 100 having active ulcers at death.

Gastric ulcers caused most deaths in men between the ages of 45 and 54 years (3.5%), the rate declining almost symmetrically in preceding and subsequent age groups. Gastric ulcers in women found incidentally and causing death were minimal in frequency with advancing age; particularly notable was the increase in incidental ulcer between the fourth and fifth decades, namely, 2.0% to 3.9%, remaining at this level in the elderly. This change is in keeping with the big rise of ulcer incidence, and complications frequently observed clinically in post-menopausal women. Estimates of the frequency of incidental gastric ulcer to the exclusion of ulcer deaths again confirmed that ulcer frequency doubled at this age. One in 45 women showed lesions in the fourth decade and one in 22 in the fifth decade, an increase of 2.3% to 4.6% (Fig. 3).

Comparison of ulcer recurrence in men and in women showed, for the first time, a less well-marked male predominance, the total lesions causing death and found incidentally being only slightly more common in men, in the ratio of 1.3 : 1. Ulcers still caused twice as many deaths in men as in women, 2.02 : 1, but were found incidentally with equal frequency, 1.1 : 1, active ulcers being found more often in men, 1.8 : 1, and scars in women, 0.9 : 1. Deaths due to gastric ulcer occurred three or four times more commonly in men than in women below the age of 55 years, but in the sixth and seventh decades occurred more commonly in women with frequencies of 0.96 and 0.3 to 1 respectively. A similar male predominance in ulcers found by chance occurred under 55 years, in the fourth decade ulcers being twice as common in men but gastric ulcers were found more frequently in elderly women, the ratio over 75 years being 0.5 : 1.

**RELATIVE FREQUENCIES OF DUODENAL AND GASTRIC LESIONS.**—When the frequency of duodenal to gastric lesions was investigated, in contradistinction to most necropsy series, a clear predominance of duodenal ulcer emerged most markedly in men and less so in women. Lethal and non-lethal duodenal ulcers were present approximately three times as commonly in men as were gastric ulcers and were almost one and a half times more common in women. Duodenal ulcers in men caused two to three times more deaths as did gastric ulcers. In women, however, deaths were more often due to gastric causes in the overall ratio of 0.9 : 1. When ulcer deaths were excluded, active duodenal ulcers were found twice as often in men

as were gastric, whereas four times as many duodenal scars were present, the relative frequencies being halved in women, the ratio active 1.1 : 1 and ulcer scars 2.0 : 1.

The greater proportion of deaths due to duodenal ulcer in men, though present in each age group, were most marked in the young and middle-aged where duodenal ulcers caused between three and four times more deaths than did gastric. In women the small numbers of deaths involved made differences between age groups unreliable, but again most premenopausal deaths in women were due to duodenal ulcers and most occurring after this time were due to gastric ulcer.

When ulcer deaths were excluded a clear-cut duodenal predominance was found in the incidental ulcers found in every age group in both men and in women. This was most marked in the young, relative frequencies in the first four age groups in men being approximately 21, 7, 6 and 3, to 1, and in women 7, 4, 4, 3 to 1 respectively. In middle-aged and elderly men duodenal lesions occurred three to five times as often but were only slightly more common in women of the same age group (1.1-1.7 : 1).

COMBINED GASTRIC AND DUODENAL ULCERS.— This not uncommon combination of ulcer lesions has caused much confusion in necropsy surveys; some pathologists have included the gastric and the duodenal lesions of the combined ulcers as additional single gastric or duodenal ulcers. This practice would artificially increase ulcer incidence in these sites, as more ulcers are reported than are necropsies performed, each lesion being counted twice. It was thought best to place combined lesions in a separate category, estimating their frequency independently.

One hundred and seventy-four combined gastric and duodenal ulcer lesions were found in men and 53 in women, relative overall frequencies being 2.3% and 1.1%; in men twice as many active as inactive lesions were found, namely, 1.5% to 0.8%. In women, however, they occurred with equal frequency, 0.55% and 0.53% respectively. These ulcers caused 73 deaths in men (0.9%) and 12 in women (0.2%). One hundred and one fortuitous lesions were found in men (1.3%) and 41 in women (0.8%). When ulcer deaths had been excluded, one in 50 males (1.6%) and one in 100 females (0.9%), dying in hospital from causes other than ulcer, showed combined gastric and duodenal lesions

TABLE IV  
FREQUENCY OF ACTIVE ULCERS AND SCARS IN EACH SITE IN COMBINED GASTRIC AND DUODENAL ULCERS IN LEEDS SURVEY

	Age Group Related	Both Active		Active Gastric Ulcer and Duodenal Scar		Active Duodenal Ulcer and Gastric Scar		Gastric and Duodenal Scars	
		Related	Unrelated	Related	Unrelated	Related	Unrelated	Related	Unrelated
M A L E S	-25	—	—	—	—	—	—	—	2 (0.11)
	25-	2 (0.36)*	1 (0.18)	2 (0.36)	1 (0.18)	1 (0.18)	1 (0.18)	—	4 (0.72)
	35-	2 (0.41)	2 (0.27)	5 (0.68)	3 (0.41)	1 (0.14)	—	1 (0.14)	4 (0.54)
	45-	10 (0.84)	3 (0.25)	6 (0.50)	3 (0.25)	3 (0.25)	1 (0.08)	—	15 (1.25)
	55-	7 (0.42)	5 (0.30)	15 (0.90)	8 (0.49)	3 (0.18)	2 (0.12)	—	18 (1.09)
	65-	4 (0.31)	3 (0.23)	4 (0.31)	6 (0.45)	2 (0.15)	—	—	13 (1.02)
	75	2 (0.43)	1 (0.22)	2 (0.43)	1 (0.22)	—	—	—	4 (0.86)
			28 0.36	15 (0.19)	34 (0.44)	22 (0.28)	10 (0.13)	4 (0.05)	1 (0.01)
F E M A L E S	-25	1 (0.07)	—	—	—	—	—	—	—
	25-	—	—	—	—	—	—	—	1 (0.28)
	35-	—	1 (0.21)	—	2 (0.42)	—	—	—	1 (0.21)
	45-	—	—	3 (0.40)	2 (0.27)	—	—	—	6 (0.67)
	55-	1 (0.10)	—	1 (0.10)	2 (0.20)	—	—	—	10 (1.05)
	65-	1 (0.13)	2 (0.26)	5 (0.75)	3 (0.39)	—	—	—	6 (0.78)
	75	—	—	—	3 (1.13)	—	—	—	2 (0.75)
		Total	3 (0.06)	3 (0.06)	9 (0.18)	12 (0.24)	—	—	—

\* Percentage incidence in brackets.

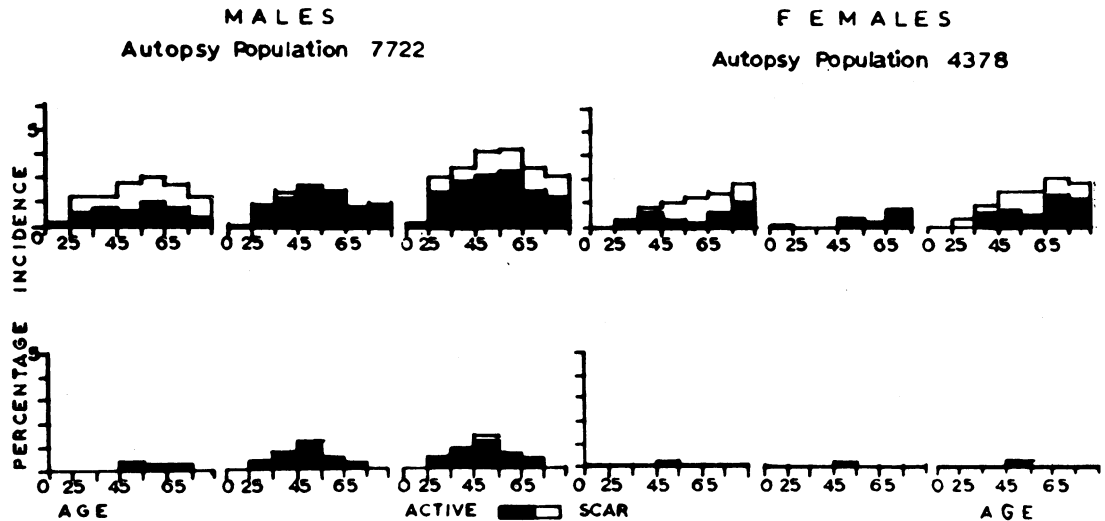


FIG. 6.—The observed necropsy incidence of chronic combined gastric and duodenal ulcers (above) and of stomal ulcers (below) at necropsy in Leeds between 1930 and 1949.

	Males			Females		
	Ulcers Unrelated	Ulcer Deaths	Total Ulcers	Ulcers Unrelated	Ulcer Deaths	Total Ulcers
Active Scars	41 (0.5%) 60 (0.8%)	72 (0.9%) 1 (0.01%)	113 (1.5%) 61 (0.8%)	15 (0.3%) 26 (0.5%)	12 (0.2%) —	27 (0.6%) 26 (0.5%)
Total	101 (1.3%)	73 (0.9%)	174 (2.3%)	41 (0.8%)	12 (0.2%)	53 (1.1%)
<i>Chronic Stomal Ulcer</i>						
Active Scars	3 (0.03%) 1 (0.01%)	30 (0.30%) 1 (0.01%)	33 (0.33%) 2 (0.02%)	1 (0.02%) —	1 (0.02%) —	2 (0.04%) —
Total	4 (0.04%)	31 (0.31%)	35 (0.35%)	1 (0.02%)	1 (0.02%)	2 (0.04%)

(Fig. 6). The types of pathological lesion found in the two sites are summarized in Table IV.

Ulcer deaths due to combined ulcer were most common in men between the ages of 35 and 65 years and accounted for 1.5% of the necropsy deaths, while all 12 deaths occurred in postmenopausal women. Deaths in men were most often due to active lesions in both sites (0.4%) or to a chronic gastric ulcer with a duodenal scar (0.4%).

Ulcers found incidentally in men occurred most often between 45 and 74 years, when approximately one in 50 were affected and in the same age groups in women when the incidence had halved at 1.1% to 1.4%. Between 2.2% and 2.8% of middle-aged and elderly men dying in hospital, exclusive of ulcer, and between 1.2% and 1.7% of women in the same age group showed combined lesions. Scars in both sites were found incidentally as the most common pathological lesion in men and in women, the rate being 0.8% and 0.5% respectively. An active gastric ulcer with a duodenal scar occurred next most commonly (0.3% in men and 0.2% in women).

Active ulcers in both sites were incidentally found with similar frequency in men (0.2%) but more rarely in women (0.06%), while the last possible combination of an active duodenal ulcer with a gastric scar appeared unique to men, causing 0.1% of deaths and being found incidentally in 0.05%.

Four times as many ulcer deaths occurred in men as in women, while incidental active ulcers and ulcer scars occurred most commonly in men at ratios of 1.7 and 1.5:1, respectively. Male incidental ulcers occurred twice as commonly in the fourth and fifth decades and only in elderly women were combined lesions more common, the rates being 0.7:1.

**CHRONIC STOMAL ULCER.**—Thirty-five chronic stomal ulcers were found in men (0.35%) and had caused death in 31 (0.3%) and two were demonstrated in women (0.4%). The overall and age distribution of the ulcers found is shown in Fig. 6. The small numbers involved make definite conclusions unwise but a similar pattern to that of

duodenal ulcer was obtained with a maximal incidence in middle life between 45 and 54 years.

**OTHER ULCERS.**—Chronic oesophageal ulcers were found in five men in the Leeds survey (0.05%) and had caused three deaths (0.03%), all save one occurring over the age of 65 years. No oesophageal ulcers were reported in women. By carefully tracing the clinical notes it was possible to determine the site and type of case for which incidental gastrectomies had been performed, ulcers being included under the appropriate headings. The few cases where this could not be traced or the type of ulcer classified were excluded from the study.

**FREQUENCY OF CHRONIC ULCER IN THE NATIONAL SURVEY IN 1956**

The frequency of chronic peptic ulcers demonstrated in the national survey conducted in 1956 is indicated in similar fashion in Figs. 7-9, the incidence of all the lesions in men and women considered together being indicated in Fig. 7.

**ALL CHRONIC ULCERS.**—Five hundred and eighteen ulcers were found in 12.5% of the 4,151 necropsies reported, and active lesions were demon-

strated twice as commonly as were ulcer scars, 7.2% to 4.3%. Ulcers had caused 185 necropsy deaths (4.5%), and had been found by chance in 333 necropsies (8.0%). When ulcer deaths had been excluded (Fig. 8) this survey would estimate that one in 12 men (8.3%) had at some time in their lives had a peptic ulcer, slightly more than half having healed ulcers at death, in that ulcer scars were found in 4.6% and active ulcers in 3.7% respectively.

When the age distribution of the ulcer deaths is considered, a differing pattern to the Leeds series was obtained; ulcer deaths in men reached a frequency of 4.3% by the age of 35 years, becoming more common with advancing age to 5.7% between 55 and 75 and 6.4% over 75 years, a pattern of ulcer deaths which conformed more to clinical experience than did the Leeds series. Ulcers were found incidentally most commonly in middle age when one in nine men showed ulcer lesions, one in 16 having scars at death. The figure only increased slightly to 10.5% to 12.0% when ulcer deaths have been excluded, more scars, 5.9% to 7.3%, being found than active ulcers, 4.0% to 4.7% (Figs. 7 and 8).

One hundred and eighty-four ulcer lesions were found in 6.3% of the 2,936 necropsies performed in

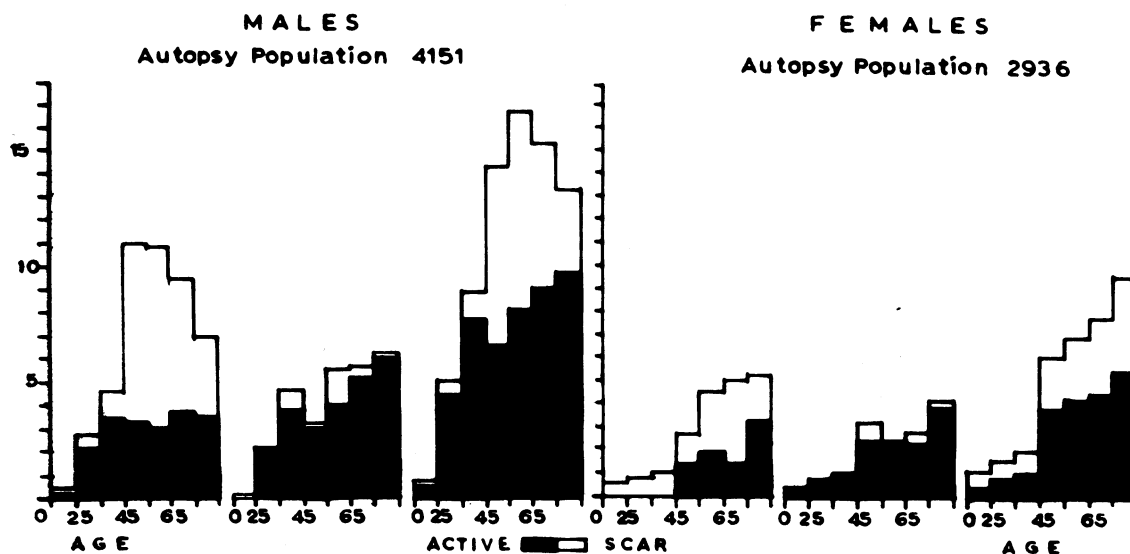


FIG. 7.—The percentage frequency of all chronic ulcers demonstrated in the 1956 national survey.

	Males			Females		
	Ulcers Unrelated	Ulcer Deaths	Total Ulcers	Ulcers Unrelated	Ulcer Deaths	Total Ulcers
Active	133 (3.2%)	169 (4.07%)	302 (7.2%)	41 (1.4%)	67 (2.3%)	108 (3.7%)
Scars	166 (1.5%)	14 (0.34%)	180 (4.3%)	56 (1.9%)	7 (0.2%)	63 (2.2%)
<b>Total</b>	<b>333 (8.02%)</b>	<b>185 (4.46%)</b>	<b>518 (12.5%)</b>	<b>110 (3.7%)</b>	<b>74 (2.5%)</b>	<b>184 (6.3%)</b>

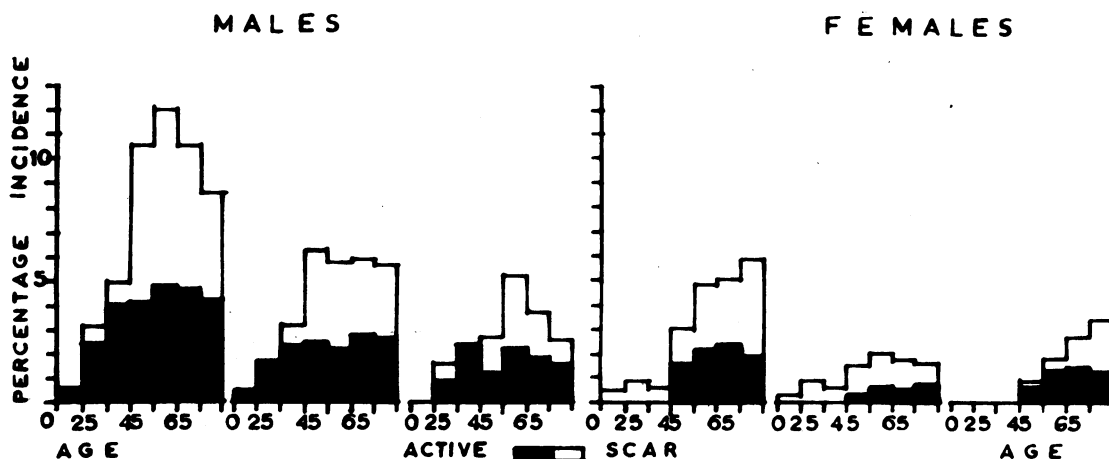


FIG. 8.—The best estimate of ulcer frequency in 1956 in the general population as a whole, namely, the incidence of chronic peptic ulcer, excluding ulcer deaths.

	Males			Females		
	Total	Duodenal Ulcer	Gastric Ulcer	Total	Duodenal Ulcer	Gastric Ulcer
Active	133 (3.7%)	72 (2.0%)	49 (1.3%)	41 (1.5%)	9 (0.33%)	24 (0.88%)
Scars	166 (4.6%)	93 (2.6%)	56 (1.6%)	56 (2.1%)	28 (1.0%)	23 (0.85%)
Total	333 (8.3%)	165 (4.6%)	105 (2.9%)	105 (3.9%)	37 (1.4%)	47 (1.7%)

women, again more active lesions than ulcer scars being found, 3.7% to 2.2%. The 74 ulcer deaths in women accounted for 2.5% of necropsy deaths, an almost identical figure to that observed in Leeds. Of 342 ulcer lesions found incidentally in 3.7% of necropsies, similar proportions, 1.4% and 1.9%, were active and inactive lesions. When ulcer deaths had been excluded rather fewer than one in 25 women (3.9%) had at one time developed ulcers, while one in 66 (1.5%) had active lesions at death. When the age distribution of the lesions was considered (Figs. 7 and 8), although, as in the Leeds series, ulcers increased in frequency with age, the tendency for postmenopausal women to develop ulcers was more strikingly shown. In the third and fourth decades ulcer deaths in women trebled in frequency from 1.1% to 3.4%. Ulcers were found incidentally twice as commonly, 1.1% to 2.8%, and, if lethal and non-lethal ulcers are considered together, frequency is again trebled from 2.1% to 6.2%. Approximately one in 20 middle-aged or elderly women had at some time suffered from peptic ulcer (3.0% to 6.9%) while approximately one in 33 middle-aged and one in 23 elderly women had died from ulcers in the necropsy population studied.

Ulcers caused nearly twice as many deaths and were found by chance twice as often in men as in women. The small number of ulcers observed in

women before the menopause make sex comparisons before this age unwise, but sex difference over 45 years become less apparent with advancing age, the male predominance reducing in successive decades to 3.9, 2.4, 1.9, and 1.3 : 1, respectively.

**CHRONIC DUODENAL ULCER.**—The frequency and age distribution of the chronic duodenal ulcer lesions found is illustrated in Fig. 9. In men, 263 ulcer lesions were found in 6.3% of the necropsy examinations conducted, of which 3.9% were active and 2.4% were ulcer scars. Ninety-eight duodenal ulcers had caused 2.4% of the necropsy deaths, while 165 were found incidentally in 4% of the examinations, being active ulcers or ulcer scars in almost similar proportions, 1.7% and 2.2%. The incidental finding of ulcer after ulcer deaths had been excluded would estimate duodenal ulcer frequency as one in 22 (4.5%) men, of whom one in 50 had active ulcers at death. The discrepancy of duodenal scars between the two surveys has already been commented on and can clearly be seen if Figs. 4 and 9 are compared, though the overall age distribution is similar.

As only eight deaths occurred in young men definite conclusions would be unwise, but it is of interest to note that the percentage of young men dying from this cause is only slightly less than in the

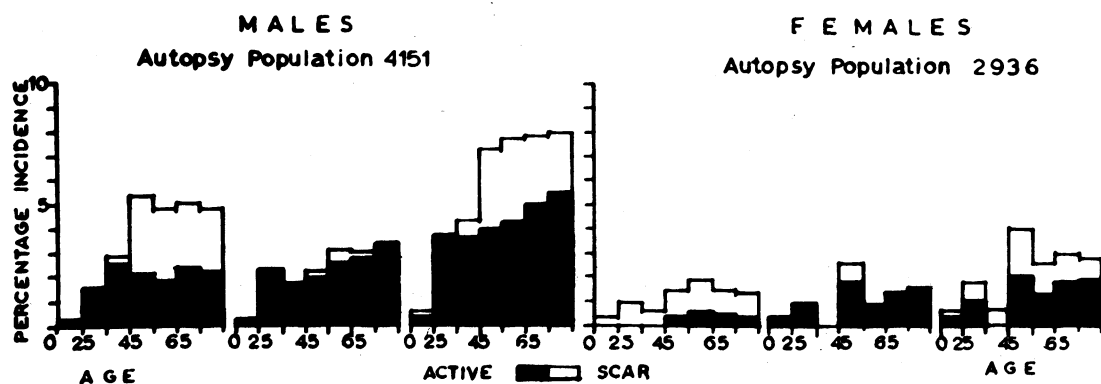


FIG. 9.—Chronic duodenal ulcer lesions demonstrated in the national 1956 survey.

	Males			Females		
	Ulcers Unrelated	Ulcer Deaths	Total Ulcers	Ulcers Unrelated	Ulcer Deaths	Total Ulcers
Active Scars	72 (1.7%) 93 (2.2%)	90 (2.2%) 8 (0.1%)	162 (3.9%) 101 (2.4%)	9 (0.3%) 28 (0.9%)	29 (0.9%) 3 (1.0%)	38 (1.3%) 31 (1.0%)
Total	165 (3.9%)	98 (2.3%)	263 (6.3%)	37 (1.2%)	32 (1.9%)	69 (2.3%)

middle-aged and elderly where ulcers caused 3.1% of all deaths. Ulcers, found by chance, occurred most commonly in middle-aged men of whom one in 19 had ulcers, the rate remaining at rather less than this frequency with advancing age. Active duodenal ulcers reached a frequency of one in 50 necropsies by 35 years and remained around this level in all succeeding decades. When ulcer deaths had been excluded, ulcer frequency in the fourth and subsequent decades approximated to one in 16 necropsies (5.6% and 6.2%) (Fig. 9).

The relatively small numbers of duodenal ulcers demonstrated in women will allow only limited conclusions. Sixty-nine ulcers were found in 2.3% of necropsies, active and inactive lesions being in similar proportions, 1.3% and 1.1%. Thirty-two duodenal ulcers had cause 1.1% of the necropsy deaths, while 37 (1.3%) had been found incidentally, the majority (0.9%) of which were healed. Again an increase in both fortuitous and lethal ulcers is demonstrated in postmenopausal women, when between one in 50 and one in 60 women show fortuitous lesions after ulcer deaths are excluded. An overall male predominance is again shown, both in ulcers causing death, 2.2 : 1, and ulcers found incidentally, 3.2 : 1, in the overall series, and in most age groups over 45 years.

**CHRONIC GASTRIC ULCER.**—The frequency and age distribution of the 175 gastric ulcer lesions found in men and the 79 demonstrated in women is shown in Fig. 10.

Gastric ulcers were the cause of death in 1.7% of male and 1.1% of female necropsies, being found incidentally in 2.5% and 1.6% of examinations respectively. As many ulcer scars as active ulcers were found in both sexes. Neglecting ulcer deaths, approximately one in 34 men (2.9%) and one in 59 women (1.7%) had developed gastric ulcers, half of which had healed before death in each instance.

Gastric ulcers became progressively more common with advancing age in women and were rarely observed in premenopausal women. Ulcer deaths doubled in frequency after the menopause, from 0.9% in the fifth decade to 2.2% in elderly women. Incidental ulcers more than trebled in frequency between the same two age groups, from 0.8% to 3.1%. Between one in 30 and one in 50 (1.8%-3.4%) of middle-aged and elderly women seemed to have had gastric ulcers in their life time when ulcer deaths had been excluded. In men, for some reason, gastric ulcers accounted for a disproportionately high fraction of 2.7% of deaths between 35 and 44 years, approximating to the number of deaths in men over 55 years, when one in 50 were affected (2.0%-2.7%). Ulcers were found fortuitously most commonly in the fifth decade when roughly one in 25 men showed gastric ulcer lesions (4.3%), rather less than half (1.8%) of which were active. When ulcer deaths were excluded, incidental ulcer lesions demonstrated in the hospital necropsy population would suggest that between one in 40 (2.6%) and one in 50 (5.2%) middle-aged and elderly men have at some time had gastric ulcers, of which

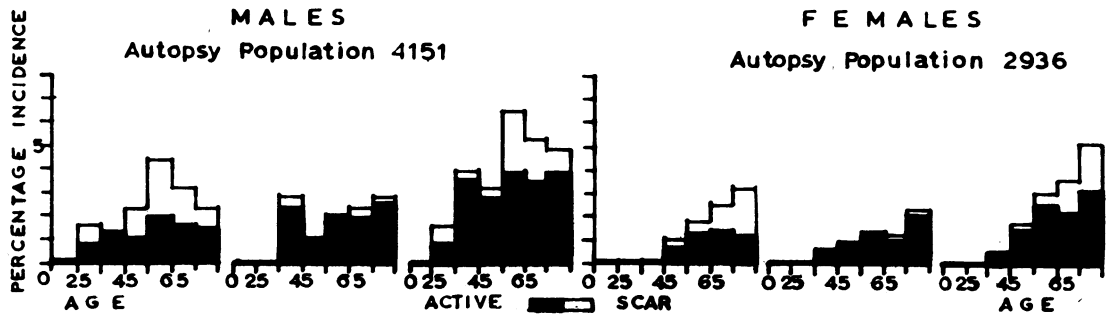


FIG. 10.—The frequency of 175 chronic gastric ulcers found in men and 79 found in women in the 1956 survey.

	Males			Females		
	Ulcers Unrelated	Ulcer Deaths	Total Ulcers	Ulcers Unrelated	Ulcer Deaths	Total Ulcers
Active Scars	49 (1.0%) 56 (1.1%)	65 (1.4%) 5 (0.1%)	114 (2.3%) 61 (1.2%)	24 (0.8%) 23 (0.8%)	29 (1.0%) 3 (0.1%)	53 (1.8%) 26 (0.9%)
Total	105 (2.1%)	70 (1.5%)	175 (3.5%)	47 (1.6%)	32 (1.1%)	79 (2.7%)

rather more than half had healed at death (Figs. 8 and 10).

The male predominance, common to most other types of ulcer, was less clearly shown for gastric ulcer and tended to disappear with advancing age. While two and a half times more gastric ulcers were demonstrated by chance in men than in women of 45 years old, this ratio dropped to 1.3 : 1 at 65, and in women over 75 years gastric ulcer was found more often in women giving a ratio of 0.71 : 1. More ulcer deaths occurred in men than in women in all age groups.

**RELATIVE FREQUENCIES OF DUODENAL AND GASTRIC ULCERS.**—As in the Leeds series, in men duodenal ulcers were found incidentally approximately twice as commonly as gastric ulcers, 1.9 : 1, and caused one and a half times more deaths, 1.6 : 1, this ratio holding good for most age groups over middle age. In women, although duodenal lesions were more common in middle age, causing three times more deaths and being found incidentally 1.7 times as frequently, the ratio fell in the elderly when more deaths are due to gastric ulcer, 0.7 : 1, and more were found incidentally, 0.4 : 1. When all ulcers were considered together regardless of age distribution, as many ulcer deaths resulted from gastric as from duodenal ulcer, while more gastric than duodenal lesions were found incidentally, 0.8 : 1.

**COMBINED GASTRIC AND DUODENAL ULCER.**—Seventeen combined gastric and duodenal ulcers were found in men in 0.3% of necropsies performed and six were found in women in 0.2%. These ulcers had caused five deaths in men (0.1%) and

three in women (0.1%), and were found incidentally in 0.2% of male and in 0.1% of female necropsies. In both sexes no lesions were observed incidentally before 45 years or caused death before 55 years. The significant reduction from the Leeds series has already been commented upon, resulting from a paucity of duodenal ulcer scars (Table IV).

**OTHER ULCERS.**—Seven chronic stomal ulcers were reported in the national series (0.1%) and had caused five ulcer deaths (0.1%), all in subjects over 45 years. Three oesophageal ulcers were reported in men and had caused two deaths (0.04%) and five were reported in women causing four deaths (0.1%). The 21 men and six women who had undergone gastrectomy for peptic ulcer, and 15 men and seven women in whom the ulcer site was not stated, are included in the appropriate age group as chronic ulcers unrelated to death.

#### DISCUSSION

The information obtained in the two surveys illustrates that even though particular care was taken to report peptic ulcer lesions, significant differences in estimating ulcer incidence emerged when ulcer frequencies were compared. Some were explicable by observer error, others by possible geographical differences in ulcer incidence, and others by varying policies relating to admission and medical practice in different hospitals. While the incidence of the grosser pathological lesions agreed closely in the two studies, it was in the reporting of ulcer scars that striking differences emerged, showing that careful routine pathological examination of the stomach and duodenum seemed insufficient to

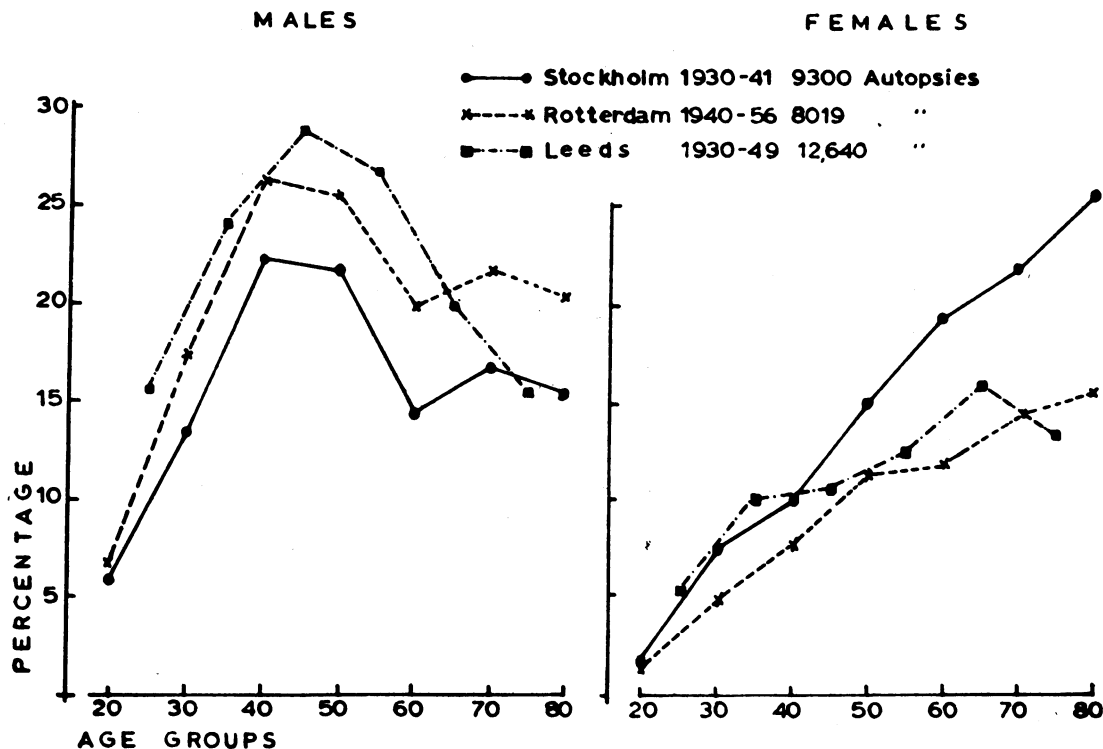


FIG. 11.—The percentage frequency of chronic peptic ulcer causing death and found incidentally in 30,000 necropsy examinations performed in Stockholm, Rotterdam, and Leeds at varying periods between 1940 and 1956 (Falconer, 1943; Levij and Straub, 1957.)

demonstrate all lesions, and that a particular specialized interest, such as was shown by Professor Stewart and his colleagues in Leeds, would demonstrate far more. For this reason, a factual statement of ulcer frequency has been presented in the circumstances in which each survey was performed and no attempt has been made to compare one with the other, nor with other surveys previously reported. The statistical fallacies of necropsy surveys have been described, particularly the limited value of overall estimates of ulcer frequency which take no account of the age distribution of the ulcer or necropsy population at risk.

It has been thought permissible to allow a limited comparison of the Leeds figures with two other necropsy studies performed over the same period, in which acute and chronic ulcer lesions were distinguished and ulcer deaths enumerated. Particular care was taken to find all ulcer lesions and careful statistical principles were observed throughout. A comparison with studies of 9,300 necropsies performed in Stockholm between 1930 and 1941 (Falconer, 1943) and 8,019 necropsies performed in

Rotterdam between 1940 and 1956 (Levij and Straub) is made in Fig. 11, where both lethal and non-lethal chronic ulcers are included.

The strikingly similar age distribution of ulcer lesions in the three towns, showing a peak frequency in men between 40 and 50 and becoming more common with advancing age in women, suggests at least some uniformity in ulcer incidence in these European cities at this particular period.

Further discussion will be limited to reiterating what is thought to represent the best estimate of ulcer frequency in the population as a whole, namely ulcers found by chance in patients dying in hospital from causes other than ulcer and excluding ulcer deaths from consideration (see Figs. 3 and 8).

The Leeds survey (Fig. 3) would estimate that between one in four and one in six men (17.4% to 23.0%) over the age of 35 years suffered from peptic ulcer, approximately one in 20 having active ulcers at death (4.1% to 7.1%). In the same age groups, approximately one in seven (13.0% to



15.3%) had duodenal, approximately one in 20 (2.3% to 5.9%) gastric, and about one in 50 combined gastric and duodenal ulcer lesions. Ulcers were found in the national 1956 survey with approximately half this frequency, although the age distribution of the lesions was similar and the frequency of active lesions comparable (Fig. 8). Ulcers occurred most commonly in subjects over 45 years of age, when approximately one in 10 men (8.2% to 12.0%) had ulcer lesions, of which half were active at death (4.0% to 4.7%). Elderly and middle-aged men in this survey showed duodenal ulcers in approximately one in 18 necropsies (5.6% to 6.2%) and gastric ulcers in about one in 30 necropsies (2.6% to 5.2%), while combined gastric and duodenal ulcers were only rarely encountered (0.5% to 1.0%). An overall predominance of duodenal ulcers compared with gastric is most marked in the young and least marked in the elderly, a fact which could be demonstrated in both surveys, duodenal ulcers being found three to five times more often in men in the Leeds survey and one and a half to two times more often in the national figures. These figures come near to the clinically observed predominance of duodenal ulcer and contrast with many previous necropsy series, where the complications more frequently attendant on gastric ulcers make them more commonly observed in hospital populations.

In women in both surveys, sharp increases in ulcer frequency occurred in pre- and post-menopausal women, increasing in successive decades from 4.5% to 9.7% in Leeds and 0.6% to 3.0% in the national figures. The overall frequency in middle-aged and elderly women was estimated at approximately one in eight women (10.1% to 14.7%) in Leeds and at the much lower frequency of one in 25 women (3.0% to 5.9%) in the national figures. While in Leeds duodenal lesions predominated in every age group, ratios of between 1.1:1 and 2.8:1 being observed in the national figures, gastric ulcers were more often encountered in the elderly, ratios reducing from 1.7:1 to 0.5:1 when duodenal and gastric lesions were compared. Duodenal ulcer frequency was estimated in middle-aged and elderly women at about one in 13 (5.0% to 8.2%) in Leeds and one in 55 (1.5% to 2.0%) in the national figures. Gastric ulcer frequencies, too, show striking discrepancies at one in 21 (4.3% to 4.8%) in Leeds and approximately one in 60 (0.9% and 3.4%) for the national figures. Combined gastric and duodenal ulcer lesions were observed in between one in 50 and one in 80 necropsies (1.2% to 2.2%) in the Leeds necropsies in postmenopausal women but were hardly ever observed in the national series (0.2%). An overall

male predominance of ulcer lesions emerged in both surveys, approximately 2:1 for total and duodenal ulcers and approximately 1.3:1 for gastric ulcers, differences again being most marked in the young and middle-aged and least apparent in the elderly in whom gastric ulcers were more commonly observed in women.

The vast amount of accumulated data has been presented as briefly as is possible. True ulcer frequencies may well lie at levels somewhere between the estimated frequency of the two surveys, but it is felt that the particular care taken by Professor Stewart and his staff in Leeds to describe and report ulcer lesions make it likely that these figures approximate more nearly to the true ulcer frequency in the population as a whole.

My thanks are due first to the late Professor Matthew Stewart for placing his departmental and personal records at my disposal and his encouragement to undertake the investigation; secondly, to the pathologists enumerated below for submitting their records for analysis in the 1956 survey; thirdly, to Mr. Jack Teale and members of the Records Department of the Leeds General Infirmary who undertook the mammoth task of punching and sorting the record cards in both surveys; fourthly, to Professor R. E. Tunbridge, who extended facilities of the Department of Medicine in Leeds for the study. Mr. Harry Revell gave invaluable help in the analysis and calculation of the data and preparation of the figures, and Miss A. Padgett undertook the exacting typing of this report.

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#### APPENDIX

##### HOSPITALS AND PATHOLOGISTS PARTICIPATING IN THE NATIONAL SURVEY IN 1956

*London*: Central Middlesex Hospital, Dr. C. Treip; St. Thomas's Hospital, Prof. W. G. Barnard and Dr. K. J. Martin; University College Hospital, Dr. R. A. B. Drury; King's College Hospital, Prof. H. A. Magnus and Dr. B. S. Cardell; Postgraduate Medical School, Prof. C. V. Harrison.

*Birmingham*: Queen Elizabeth Hospital, Dr. B. T. Davis.

*Oxford*: The Radcliffe Infirmary, Dr. A. H. T. Robb-Smith.

*Bristol*: The Royal Infirmary, Prof. T. F. Hewer.

*Leeds*: The General Infirmary, Dr. R. Carmichael, Dr. T. W. Sutherland, Dr. C. Wright, Dr. H. Thompson, Dr. I. M. P. Dawson; St. James's Hospital, Dr. W. Goldie, Dr. G. M. Bonser, Dr. W. Mitchell, Dr. J. A. Dossett.

*York*: The County Hospital, Dr. D. A. Slade and Dr. G. A. C. Summers; The City Hospital, Dr. O. Cameron; (analysis by Dr. C. N. Pulvertaft); York County Coroner.

*Newcastle*: The General Hospital, Dr. B. E. Tomlinson.

*Manchester*: The Royal Infirmary, Prof. C. Campbell.

*Glasgow*: Stobhill Hospital, Dr. J. Dick; Western District Hospital, Dr. G. M. Ritchie; Western Infirmary, Prof. D. F. Cappell; Glasgow pneumoconiosis cases, Dr. B. Lennox and Dr. Ferguson Smith.