THE GEOGRAPHICAL DISTRIBUTION OF GASTRIC AND DUODENAL ULCERS IN THE BRITISH ISLES WITH NOTES ON THE AETIOLOGY OF PEPTIC ULCER

BY

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At a meeting of the Section of Medicine of the Royal Society of Medicine Sir Arthur Hurst (1941) mentioned some remarkable differences between the incidence of peptic ulcer in soldiers and in civilians. In private practice duodenal ulcer was about four times as frequent as gastric ulcer, though in hospital practice this did not obtain (in three of the large London hospitals the statistics, both clinical and post mortem, over a good many years showed an equal incidence of gastric and duodenal cases). In the Army, apparently, duodenal ulcers were in the large majority.

In view of the increasing importance of peptic ulceration in both the Forces and the civilian population, the following investigation carried out in Aberdeen in 1938 and 1939 may be of interest.

Relative Incidence of Duodenal and Gastric Ulcer in the British Isles

During a "follow-up" investigation of 435 patients admitted to Aberdeen Royal Infirmary suffering from proved peptic ulceration the relative incidence of duodenal to gastric ulcers was found to be 6.8 to 1. When these figures were compared with others previously published it was found that the relative incidence of duodenal and gastric ulcer apparently varied slightly throughout the world, but very remarkably in the British Isles. The collected figures are shown in Table I. Although the series are not strictly comparable, some being from medical, others from surgical, wards, the findings in the different

districts are constant enough to be considered significant. Two interesting facts have been noted: (a) the apparently high incidence of gastric ulcer in the hospital patients in London; and (b) the very constant sex incidence of peptic ulcer throughout the world, whatever the relative incidence of duodenal and gastric ulcers in a given area.

(a) The relative incidence of duodenal and gastric ulcers in hospital patients varies considerably between London and the Provinces. The ratio of duodenal to gastric ulcers (male and female) in London is 1 to 1, in Leeds 2.8 to 1, and in Scotland from 6.8 to 8 to 1. Luff (1929), reporting the collective investigation from the whole of England, found the ratio to be 1.8 to 1, intermediate between the London and Leeds figures. Table Ia shows that the incidence of duodenal and gastric ulcers is very constant in private patients, both in America and in the British Isles, although the figures from America show a slightly lower ratio of duodenal ulceration to gastric ulceration. In Britain it appears that gastric ulcer is less common in the north than in the south, and, in particular, London seems to have a very high proportion of gastric ulcers (Table II).

TABLE II.—Showing the High Proportion of Gastric Ulcer
in London

	Duodenal	Gastric
London	1,667	1,826
Leeds	927	327
Scotland	1,050	154

For purposes of comparison with figures being collected from the Forces, the numbers of males in these areas are shown separately in Table III. The incidence of duodenal

TABLE III.—Incidence in Male Civilians

	Duodenal	Gastric	Ratio
London	529	426	1.2 to 1
Leeds	433	98	4.4 to 1
Scotland	639	55	11.6 to 1
Aberdeen (18-40 years)	255	28	9.1 to 1

and gastric ulcers in different age groups is available only in the Aberdeen figures, where it was found that the ratio of duodenal to gastric ulcers between the ages of 18 and 40 years, forming the bulk of the mobilized Services to-day,

TABLE I.—Relative Incidence of Duodenal and Gastric Ulcers (Hospital Cases)

Author	Duodenal			Gastric			Multiple	All Ulcers		All Ulcers				District	
	Males	Females	Total	Males	Females	Total		Male & Female	D %	G %	Male		Female		
											D %	G %	D %		G %
Burger and Hartfall (1934)	—	—	774	—	—	888	—	49	51	—	—	—	—	London	
Souttar (1927)	529	86	615	462	198	660	—	49	51	52	48	30	70	"	
Walton (1927)	—	—	278	—	—	278	—	50	50	—	—	—	—	"	
Flint (1927)	—	—	411	—	—	148	—	73	27	—	—	—	—	Leeds	
Moynihan (1920)	433	83	516	98	81	179	23	74	26	82	18	51	49	"	
Luff (1929)	832	163	995	356	182	538	—	65	35	70	30	47	53	All England	
Wilkie (1927)	234	76	310	22	30	52	51	86	14	92	8	72	28	Edinburgh	
Young (1927)	112	16	128	10	8	18	—	87	13	92	8	67	33	Glasgow	
Nicol (1939)*	293	75	368	23	31	54	13	89	11	—	—	—	—	"	
Hinton (1931)	—	—	270	—	—	34	6	85	15	93	7	71	29	Aberdeen	
Emery and Monroe (1935)	—	—	1,167	—	—	215	53	88	12	—	—	—	—	New York	
Allen (1937)	—	—	1,002	—	—	434	—	84	16	—	—	—	—	Boston	
Moutier (1932)	—	—	495	—	—	133	—	70	30	—	—	—	—	"	
Chang and Chang (1937)	173	52	225	84	26	110	20	79	21	—	—	—	—	Paris	
								67	33	67	33	67	33	Peking	

TABLE Ia.—Relative Incidence of Duodenal and Gastric Ulcers (Private Cases)

Author	Duodenal			Gastric			Multiple	All Ulcers		All Ulcers				All Ulcers	District	
	Males	Females	Total	Males	Females	Total		Male & Female	D %	G %	Male		Female			
											D%	G%	D%			G%
Barford (1928)	—	—	130	—	—	30	4	81	19	—	—	—	—	—	England	
Ryle (1932)	—	—	209	—	—	52	—	80	20	—	—	—	—	—	"	
Nicol (1939)*	149	39	188	20	21	41	—	82	18	—	—	—	—	74	26	
Eusterman and Balfour (1935)	551	150	701	223	50	273	—	72	28	71	29	75	25	79	21	
White (1926)	—	—	152	—	—	54	—	74	25	—	—	—	—	—	—	

* Unpublished.

was 9.1 to 1. Payne and Newman (1940) found a ratio of 4.2 duodenal ulcers to 1 gastric ulcer among 227 proved cases from the Forces, and Graham and Kerr (1941) reported that the ratio of duodenal to gastric ulcers among 158 serving men was 5.9 to 1. The great excess of duodenal ulcer in the Forces compared with gastric ulcer is similar to that found all over the world, excluding London.

(b) The sex incidence of peptic ulceration in both private and hospital practice is remarkably constant throughout Britain and the world generally, affecting males three times as frequently as females. In districts where the incidence of duodenal ulcer is very much higher than gastric ulcer the predominance of males is not quite so great, owing to a relative increase in the number of females suffering from duodenal ulcer (Table IV). Table I shows that this sex

TABLE IV.—Sex Incidence of Peptic Ulceration

	Males	Females	Ratio
London	1,707	499	3.4 to 1
Leeds	531	164	3.2 to 1
All England	1,188	345	3.4 to 1
Scotland	694	236	2.9 to 1

incidence of about three males to one female is very constant throughout the world. Certain differences in the aetiology of duodenal ulcer and gastric ulcer have been observed, and are here reported, as they appear to have a bearing on the problems of the geographical distribution and sex incidence.

Differences in Aetiology of Duodenal and Gastric Ulcers

Age Incidence.—The age of onset of symptoms in the majority of cases of duodenal ulcer is between 20 and 30 years. In gastric ulcer the curve for the age of onset is spread uniformly throughout life between the third and sixth decades, the maximum incidence being distributed evenly, without the marked peak between 20 and 30 found for duodenal ulcer (see Chart).

Chart showing percentage of all duodenal and gastric ulcers in 10-year groups. (Age at onset of symptoms.)

Family History.—In cases of duodenal ulcer a family history of peptic ulceration has been found more than twice as often as for gastric ulcer. In a control series of 300 cases of acute and chronic appendicitis a family history of peptic ulceration has been found with the same frequency as in the gastric ulcer patients of this series (Table V). The

TABLE V.—Family History

	Positive	Negative	% Pos.
Duodenal ulcer	76	292	21
Gastric ulcer	5	49	10
Appendicitis	29	271	10

larger number of positive family histories among the duodenal cases has been shown to be statistically significant.

Factors associated with the Onset of Relapse of Duodenal and Gastric Ulcers.—Davies and Wilson (1937) pointed out the very frequent occurrence of external events causing mental or psychological strain shortly before the onset of dyspepsia in peptic ulcer patients. They found that such events were present in 84% of their cases. Using their methods of investigation in 232 patients of this series (187 duodenal and 45 gastric ulcers) external events of a nature disturbing to the patient have been found on 160 occasions (Table VI). These events have been classified

TABLE VI.—External Factors

	Duodenal	Gastric	Total
Mental Strain:			
Worry—			
Family troubles	22	2	24
Finance	21	—	21
Employment	19	6	25
Mental overwork	14	2	16
Excessive mental drive (Culpin, 1935)	11	1	12
Total	87	11	98
Physical Strain:			
Dietetic errors	21	15	36
Unusual physical effort	10	2	12
Upper respiratory infection	—	2	2
Unexplained seasonal incidence	1	—	1
Excessive smoking	1	3	4
Miscellaneous	—	7	7
Total	33	29	62

under two headings, mental and physical. An external factor was thus found in 70% of patients, the strain being mainly mental or psycho-physiological in 43% and mainly physical in 27%. The factors most often associated with the onset or relapse of symptoms are worry and dietetic errors. There is a marked difference in the incidence of gastric and duodenal ulcers due to these two factors: mental strain is more commonly associated with the onset or relapse of duodenal ulcers; physical factors, mainly acting through irritation of the gastric mucous membrane, are more frequently associated with the onset of gastric ulcers. Worry or overwork often leads to faulty dietetic habits, and many nervous or irritable patients blame dyspepsia as the cause of their irritability. Overlapping of mental and physical factors is bound to occur, but among the patients examined and classified in Table VI one predominant factor could always be found. The larger number of duodenal ulcer cases falling in the mental strain group is statistically significant.

Ulceration of both the stomach and the duodenum was found in 13 patients of the Aberdeen series (not included in Table VI). Among these patients only 2 had associated mental and physical strain factors, both of which could be classed as important; in 5 the external factor was physical in type, in 2 mental, and in 4 no external factor of disturbing significance to the patient was discovered.

Discussion

In view of (1) the variation in relative incidence of duodenal ulcer and gastric ulcer in Britain and throughout the world, and (2) the differences noted in the aetiology of the two forms of ulcer, the following hypothesis is advanced.

Two different sets of factors are at work in the causation of peptic ulceration. These can be called "D" factors, leading to duodenal ulcer, and "G" factors, resulting in gastric ulcer. The "D" factors are usually inherited, but may be aggravated or even originated by mental stress and anxiety. They are active most frequently in the third decade of life, and appear to be psycho-physiological in character. The "G" factors, on the other hand, are not inherited, occur throughout life more or less uniformly from the second to the sixth decade, and lead to local

trauma of the gastric mucosa. The sum of the "D" and "G" factors causes peptic ulceration approximately three times as often in males as in females.

Without detailed knowledge of the environmental conditions and habits, both mental and dietetic, of the general population of this country, it is impossible to test this hypothesis satisfactorily, but arguments can be brought forward to support it.

It is probable that faulty habits of eating or occasional excesses, resulting in trauma to the gastric mucosa, occur throughout life and are not mainly concentrated in the third decade. Upper respiratory or other infections at a distance from the stomach but which may result in acute focal gastritis of a blood-borne type, and acute febrile illnesses, are also found throughout life. During the decade in which the majority of cases of duodenal ulcer start—i.e., 20 to 30—the individual is faced with the issues of success or failure in his or her profession, and has often assumed responsibilities which strain both his ability and his financial resources. Later, as security becomes more certain and responsibility is less of a strain upon the individual the incidence of duodenal ulcer falls.

If it be assumed that the "D" factors are chiefly psycho-physiological in character and the "G" factors act mainly by irritating the gastric mucous membrane locally, an explanation is supplied for the greater incidence of both types of ulcers in males. Worries of all sorts, errors of diet or excesses of eating and drinking, and irregularity in meal hours are all much more apt to occur in males than in females. The incidence of peptic ulcer, particularly of duodenal ulcer, has increased in females since the beginning of the century in common with the incidence of peptic ulcer as a whole (Wilkie, 1927), and this may be explained by the increased responsibilities assumed by and delegated to the female sex. The swing from a preponderance of gastric ulcers to a preponderance of duodenal ulcers that has occurred since the beginning of the twentieth century is due to (a) improved methods of diagnosis, (b) an increase of "D" factors (hurry, anxiety, competitive strain, etc.) which has occurred since the beginning of the present century, and (c) a reduction in "G" factors owing to an improvement in the nation's diet and a spread of knowledge regarding physiological methods of eating.

London is the only big city in the world in which an equal number of duodenal and gastric ulcer patients are treated in hospital. There are two possible explanations of the London figures: (1) that the population of London has dietetic habits that differ from those of the populations of other cities; or (2) that the percentage of patients in London suffering from duodenal ulcer who are treated as in-patients in hospital, and not as out-patients or as private patients in their homes by general practitioners, is less than in other cities all over the world.

Since the figures for the incidence of duodenal ulcers and gastric ulcers in London differ so materially from those available from other large cities all over the world, it is suggested that the second explanation given above is the correct one.

It is generally believed that peptic digestion of a devitalized area of gastric or duodenal mucous membrane is the ultimate factor in the production of peptic ulceration. The cause of this devitalization is not known for certain, and no doubt many factors play a part. Cushing (1932) and Necheles *et al.* (1938) have noted an association between nervous lesions or disturbances and peptic ulcer. In view of the above-noted aetiological importance of external factors, chiefly psycho-physiological disturbances ("D" factors), in the production of duodenal ulceration, and local

trauma to the gastric mucous membrane ("G" factors) in gastric ulceration, it is suggested that the cause of the devitalization is mainly psycho-physiological in duodenal ulcers and traumatic in the case of gastric ulcers.

Summary and Conclusions

The relative incidence of duodenal and gastric ulcers in hospital patients varies throughout Britain from 1 to 1 in London to 8 to 1 in Scotland.

Evidence is brought forward to suggest that the figures for London do not give a correct picture of the relative incidence of duodenal ulceration and gastric ulceration in that city.

The sex incidence of peptic ulceration is remarkably constant throughout the world, being approximately 3 males to 1 female.

The incidence of peptic ulceration in the Forces is what would be expected from the civilian pre-war figures.

The aetiology of duodenal and gastric ulcers varies in age incidence, familial tendency, and precipitating cause of onset.

It is suggested that psycho-physiological factors play the most important part in the production of duodenal ulcers, and that local trauma to the gastric mucosa plays the biggest part in the production of gastric ulcers.

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Detailed description and statistics have been omitted from the 1940 report of the work of the social service department, Samaritan Fund, of St. Thomas's Hospital. What speaks more eloquently is the description of the days after the first bombs had fallen on the hospital and surrounding district, an extract of which is given here to show how difficult and all the more necessary was the work of the Samaritan Fund during that time: "To Lambeth itself, the mere fact that the hospital during these dark days was continuing to treat patients had a steady effect only realized in full by those who were working there day in and day out throughout the period. Everywhere the normal and the abnormal were in strange juxtaposition. . . . Suffering was widespread. Many of the patients from one hour to another were rendered homeless: in many cases everything they treasured was lost. More than ever was it necessary for the almoners to do everything in their power to lessen and relieve the suffering in every way possible. . . . Very often the needs were small, even trivial, yet the fact that they were met promptly and adequately had a significance to the patients greatly in excess of the specific service given, for it meant that with a world in flux they could still feel that the hospital regarded them as individual human beings whose sorrows and anxieties were of consequence, whose recovery to health was something worth struggling for."