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Published online: 12 Jul 2009.

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BO CHRISTENSEN, HENRIK TOFT SØRENSEN and CARL ERIK MABECK

Institute of General Practice, University of Aarhus, DK-8000 Aarhus C, Denmark

Christensen B, Sørensen HT, Mabeck CE. Referral from general practice to dermatologists. Scand J Prim Health Care 1988; 6:29–32.

There are many unexplained differences in the rates at which general practitioners make referrals to other medical specialists. We investigated 5082 referrals from 141 general practitioners to dermatologists in Ringkøbing county in Denmark. As an expression of the referral rate to dermatologists an index of referral to dermatologists was estimated for every general practitioner. The index of referral to dermatologists was the number of referrals to the dermatologists per 1000 patients per year, including children, standardized for age and sex to the average population in Ringkøbing County. The following six variables were evaluated in relation to the referral index: 1) Distance to the dermatologists, 2) number of doctors per practice, 3) number of consultations per general practitioner per year, 4) number of patients registered, 5) number of consultations per 1000 patients per year standardized for age and sex, and 6) number of supplementary procedures per consultation. Stepwise multiple linear regression analysis was used. The study showed that the referral index to dermatologists fell both with distance to the dermatologist and with the number of supplementary procedures per consultation. No correlation was found between the referral index and the four other variables studied.

Key words: referral, general practice, dermatology.

C. E. Mabeck, MD, Institute of General Practice, Finsensgade 10, DK-8000, Aarhus C, Denmark.

The number and location of specialists in private practice in Denmark are to some extent regulated by the public health authorities. In their planning, knowledge of the factors which determine the referral rate from general practice are significant. However, only a few investigations about these problems have been carried out (1). A few studies about relationships between referral rate and access to a specialist have given contradictory results (2, 3, 4). Although these studies have taken some confounding factors into account, others have been omitted, e.g. general practitioners' (GP) educational background and working conditions.

In a previous analysis of referrals to specialist from general practice in a Danish county (5), we found that differences in specialist cover size of practice, work load, number of doctors per practice, practice activity and amount of supplementary diagnostic and therapeutic investigation accounted for only 16% of the observed variation in referral rate.

The present study analyses more specifically the referrals from general practice to dermatologists.

Dermatology has been chosen because 1) very few GPs have postgraduate clinical training on a clinical department, 2) there were no department of dermatology in the county, 3) many patients are referred from general practice to a dermatologist, 4) the precondition for public payment to treatment by a practising dermatologist is referral from a general practitioner.

MATERIALS AND METHODS

Our study was carried out on data from the National Health Service (NHS) in Ringkøbing county. In the Danish NHS more than 95% of the patients are registered with their GP of choice, and none other. The patients have the right to free treatment from their GP. Treatment by a specialist is also free after referral from the GP. The GPs and specialists are paid for each consultation and supplementary diagnostic and therapeutic procedure by the NHS after notation, which includes the personal registration number of the patient. The NHS has the number of patients on the doctor's lists, and the number of

doctors in practice. In this way it was possible to obtain information about the referral pattern.

The study included 5082 referrals to dermatologists during 1983 from 141 GPs. There were 148 GPs in Ringkøbing county. Seven were excluded from the material: one practice was sold, two GPs had less than 300 patients each, and in four cases the practice form changed during the study period.

As an expression of the referral rate to a dermatologist, an *index of referral to dermatologist* was estimated, being the number of referrals to the dermatologist per 1000 patients registered on the doctors' lists, including children, standardized for age and sex to the average population of Ringkjøbing county.

For each GP in the county the following six variables were calculated: 1) Distance to the dermatologist: The GPs were divided into the following three groups according to the distance to the nearest dermatologist: short (0–4 km), medium (5–20 km) and long distance to the dermatologist (21+ km). As a measure of work load, the following two variables were used: 2) number of patients registered, and 3) number of consultations per GP per year. As a measure of practice activity, the following two variables were used: 4) number of consultations per 1000 patients per year, standardized for age and sex, and 5) number of supplementary procedures, diagnostic and therapeutic, per consultation. 6) The practice conditions were classified as single-handed or partnership according to the number of doctors in the practice.

All the above parameters were extracted from the County Health Service. Bivariate plots showed covariation between some of the variables. On this background, a multivariate analysis was made in order to eliminate confounding factors. The multivariate analysis was made by stepwise linear regression analysis with backward elimination, known as BMDP analysis 2R (6).

The linear regression model fitted to data was:

$$y = a + b1 \times 1 + b2 \times 2 + \ldots + bi \times i$$

where y (i.e. the dependent variable) was the index of referral to dermatologist, $x1, \ldots, xi$ were independent variables, $b1, \ldots, bi$ were the regression coefficients, a was the intercept.

By stepwise regression analysis with backward elimination, all the independent variables were initially included in the equation. In each step of the analysis, the most insignificant independent vari-

Table I. *Multiple regression analysis with index of referral to dermatologist as dependent variable*

Variable	Coeffient	SE	p-Value
Distance to dermatologist	−5.0353	1.3804	0.0001
Number of supplementary diagnostic and therapeutic procedures	−34.8395	15.9177	0.029
Number of doctors in practice			0.65
Number of consultations per general practitioner per year			0.60
Number of patients per general practitioner			0.55
Number of consultations per 1000 patients			0.20

able was eliminated. The procedure was continued until the model contained only significant variables. p-Values of <0.05 were regarded as significant. The regression coefficients and p-values were then calculated. The variables were plotted against the index of referral to dermatologist. The sign of the regression coefficient does not need to be the same as that of the correlation between the two variables concerned. p-Values for statistically insignificant variables were calculated.

By application of the residuals in probit diagrams, the statistical model was found suitable. In order to describe the amount of variation in the index of referral to dermatologist that could be explained by the applied model r^2 was calculated.

RESULTS

The median for the index of referral to a dermatologist was 21 referrals per 1000 patients per year (lower–upper quartiles: 14–27, minimum–maximum value: 1–42). The regression coefficients and p-values of the independent variables are illustrated in Table I.

There was a significant correlation between the referral index and specialist cover ($p = 0.00001$). The better the specialist cover, the higher the referral rate (Fig. 1). Fig. 2 shows that the referral rate
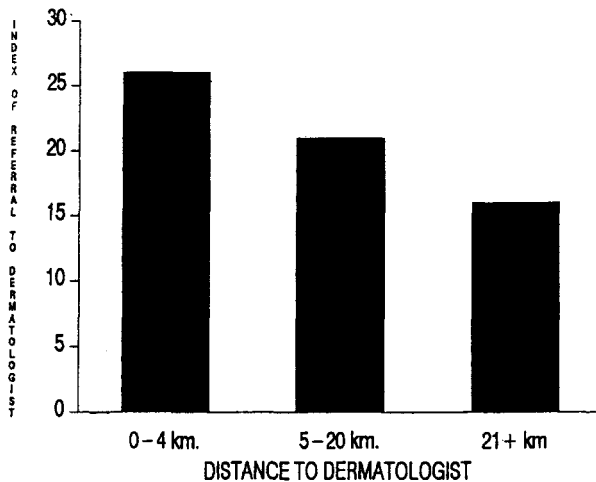
Fig. 1. Referral rate to dermatologist in relation to distance to dermatologist.

fell with increased number of diagnostic and therapeutic procedures per consultation (p=0.029). No correlation was found between the index of referral to a dermatologist and the number of doctors in practice (p=0.65), the number of consultations per GP per year (p=0.60), number of patients registered (p=0.55) nor with the number of consultations per 1000 patients, standardized for age and sex per year (p=0.20), (Table I). Our model, with the included six variables, explained 23% of the total variation in the index of referral to dermatologists.

DISCUSSION

The Danish NHS is suitable for retrospective studies of GPs' referral rates without introducing bias, since all doctor–patient contacts and supplementary diagnostic and therapeutic procedures are registered. But it is not possible to distinguish between referrals for diagnostic or therapeutic reasons. Apart from seven GPs who were excluded for technical reasons, all the GPs in Ringkøbing county were included in the study. In the county one-doctor practices are relatively underrepresented, compared with the rest of Denmark.

As mentioned, other studies of the correlation between access to specialists and referral rate could be confounded by differences in the participating doctors' qualifications. In the present study, dermatology was chosen because very few practitioners have postgraduate clinical training in this discipline, there were no dermatology departments in the Ringkøbing county hospitals and specialists in private practice were the only possibility for consultant in dermatology.
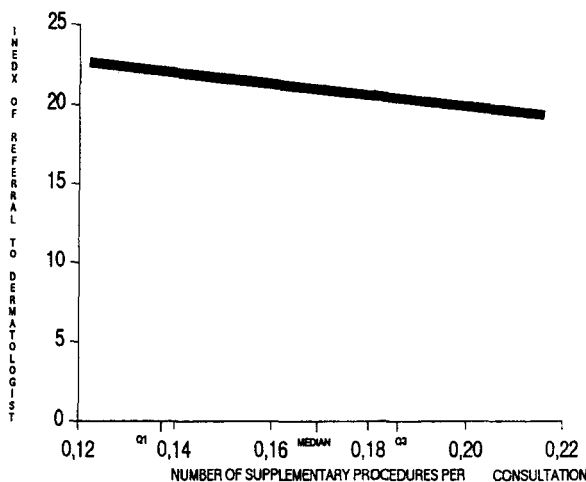

Fig. 2. Referral rate to dermatologist in relation to suppl. procedures.

We found that the referral rate to dermatologists increased with decreasing distance to dermatologists. This is in agreement with our previous study (5) of referral to other specialities from general practice, where it was shown that referral rate increased with a better access to specialists. Studies in The Netherlands (2, 3) and in USA (4) has demonstrated a similar relationship, despite differences in the study design. Reanalysis made by Van der Zee of a study from England (2) showed, however, no relationship between referral rate and distance to the specialist. The GPs' opinion about specialist cover in Ringkøbing county was investigated in 1983 (7). Ninety-five per cent of the doctors were content with the existing access to dermatologists, despite great differences in this access. It seems as if the GP adapts his work to the existing conditions and, therefore, do not complain about differences in access to specialists. But the health authorities have the responsibility to secure equal access to specialists for all patients. The correlation between distance to a dermatologist and use of medical expertise demonstrated in this study indicates that a better specialist distribution is required.

The possibility exists, that the referral rate is related to the work load. Frimodt-Møller showed (8) a positive correlation between the referral rate and the number of patients on the doctor's list. But in the present study no such correlation was found. The number of patients on the list is, however, only an indirect expression for the work load. A better expression is probably the number of contacts with patients per year. In a comprehensive study in The Netherlands (2), a positive correlation was found between the referral rate and the number of contacts per patient. Our previous study indicated also that doctors with lesser work load have a lesser referral rate to specialists in general. In the study, however, no such correlation was found. GPs with a heavy work load did not refer patients more frequently to dermatologists than colleagues with minor work load. It should be emphasized that many contacts do not always indicate a heavy work load because the average time spent per patient may vary from one GP to another.

The index of referrals to a dermatologist decreased with an increasing number of supplementary diagnostic and therapeutic procedures performed in practice. It seems as if doctors with a more intensive use of diagnostic and therapeutic procedures has a lesser demand for referral to a

dermatologist. However, our previous study (5) showed no such reduction in demand for medical specialist in general with increasing number of diagnostic and therapeutic procedures.

Daily contacts with colleagues in a partnership practice could possibly for several reasons reduce the demand for assistance from specialists. Despite that we found no differences in the referral rates between doctors in single-handed and partnership practices. This is in agreement with another Danish study (8).

Our study was based upon quantitative parameters, including the factors which the health authorities are able to influence, e.g. access to specialist, practice size, work load, and practice type. However, the model, with the six variables included, explained only 23 % of the total variation in referral rate to a dermatologist. Other factors in relation to the GPs and their working routines as well as patient-related factors, seems to have a considerable influence on referral rates to specialists (9), and should be studied in future investigations.

ACKNOWLEDGEMENTS

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