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Factors influencing sex differences in numbers of tuberculosis suspects at diagnostic centres in Pakistan

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SUMMARY

SETTING: DOTS-reporting tuberculosis (TB) diagnostic centres across Pakistan.

OBJECTIVES: To quantitatively investigate the influence of diagnostic centre characteristics on the number of female and male TB suspects registered at diagnostic centres.

DESIGN: Ten districts were selected across the four provinces of Pakistan. Data were collected on male and female TB suspects in all diagnostic centres within each district. A structured questionnaire was used to collect data on characteristics of the diagnostic centres. Multiple linear regression analysis was conducted to evaluate the influence of each characteristic on sex differences in the numbers of suspects.

RESULTS: Two diagnostic centre characteristics were associated with higher numbers of female than male TB suspects: catering to the local catchment area (P = 0.001) and being accessible on foot (P = 0.002). The following characteristics were associated with higher numbers of male than female TB suspects: being open after 2 pm (P = 0.041), having more than five doctors working at the centre (P = 0.019), and having more than 100 suspects registered per quarter (P = 0.008).

CONCLUSIONS: Smaller, local diagnostic centres that are accessible on foot registered more female than male TB suspects. More centralised facilities located further from homes, larger facilities and those with evening opening hours registered more male than female suspects.

KEY WORDS: tuberculosis; health-seeking behaviour; gender; diagnosis

OF THE ESTIMATED 9.4 million patients who develop tuberculosis (TB) every year worldwide, 3.6 million remain undiagnosed.[1] This is equivalent to almost 10 000 new TB cases going undiagnosed every day. In Pakistan, one of the high TB burden countries, approximately 297 000 new TB cases (all forms) occur per year, of which one third remain undetected.[2] Increasing the proportion of TB cases who are correctly diagnosed and treated and reducing the delay to diagnosis are central to controlling TB.

In developing countries, only a third of newly notified cases are women.[3] It remains unclear whether fewer women develop TB every year, or if women face greater barriers to accessing diagnosis. As the DOTS TB control strategy relies on passive case finding, barriers to visiting a TB diagnostic centre can determine who is able to be diagnosed and treated. There is evidence from studies on active case finding[4] and on delays to diagnosis[5,6] that TB cases in women are differentially being missed by the current case finding system.

Studies in South Asian countries have indicated that restrictions on women's mobility affect access to health care.[7–10] In several studies conducted in Pakistan, women have reported that they face difficulties in travelling, and that it is the norm for women to be accompanied to health centres.[11,12]

Delays to diagnosis and barriers to accessing health services are often studied in relation to factors associated with the individual, such as sex, age and education level. Barriers to accessing TB diagnostic centres can also be studied in relation to the characteristics of the diagnostic centre. Health centre characteristics influencing access to health services can be divided into two categories: socio-organisational and geographic.[13] Geographic attributes are related to the convenience of physical access to a diagnostic centre, such as the travel distance, time, costs and transport requirements associated with reaching a facility. Socio-organisational attributes are related to the set-up of the facility, and include factors that facilitate or hinder the efforts of patients to obtain care once they have reached the diagnostic centre. Examples are whether the facility is public or private and the fee scale.

A large body of research has assessed the impact of these heath centre characteristics on health-seeking behaviour and access to care. However, few studies have analysed whether the characteristics of health

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centres have different effects on the health-seeking behaviour of men and women. Some studies on sex differences in general health-seeking behaviour indicate that different factors may be important to men and women in choosing a health facility. A study in India found that distance was a much greater barrier to women than to men with similar incomes.[10] In Ghana, quality of service and service cost were found to have a greater effect on utilisation by males, whereas distance had a greater effect on utilisation by females.[14] The literature on preferences regarding TB-related health services indicates that women in several Asian settings prefer traditional healers or private practitioners over government centres.[5,6,15]

From a programme planning point of view, it is important to understand how factors associated with physical access to a diagnostic centre and the type of services provided influence the number of male and female TB suspects using the centre.

The objective of the present study was to quantitatively investigate the association of diagnostic centre characteristics with sex differences in the number of suspects registered at diagnostic centres across Pakistan.

STUDY POPULATION AND METHODS

Data collection on outcome and explanatory variables

There are 110 districts in the four provinces of Pakistan. This study was conducted in 10 districts sampled from all provinces. Random sampling was chosen, as it allows most external validity of results from the sample to the entire country.[16] However, owing to security concerns in Balochistan and Khyber-Pakhtunkhwa (KPK), purposive selection of districts was the only feasible option in these provinces. In Sindh and Punjab, sampling units (districts) were weighted according to the number of smear-positive cases notified to the National TB Control Programme (NTP) in 2007, and the probability of selection was proportional to the weight of each sampling unit. The following districts were selected: Karachi (Sindh), Thatta (Sindh), Badin (Sindh), Narowal (Punjab), Sialkot (Punjab), Quetta (Balochistan), Ziarat (Balochistan), Mansehra (KPK), Batgram (KPK) and Kohistan (KPK). A map of Pakistan indicating the position of these districts is shown in the Figure.

The data collection strategy was designed to take advantage of the existing World Health Organization/NTP TB monitoring infrastructure. All diagnostic centres reporting data to the WHO/NTP maintain a laboratory register in which they record information on TB suspects. A TB suspect is defined as a patient who is referred by the attending physician for sputum microscopy based on his or her clinical symptoms. Information on each TB suspect's age, sex and sputum microscopy test results is recorded in the

Figure A map of Pakistan indicating the position of study districts.

standardised laboratory registers. Quarterly intra-district meetings are held by the WHO/NTP, which one or more representatives from each diagnostic centre in the district attend with their laboratory registers. The research team attended the intra-district meeting in each selected district in October 2008. For every diagnostic centre in the district, digital photographs of all pages of the laboratory register from 1 July to 30 September 2008 were taken during the meetings. Data on TB suspects registered at each diagnostic centre was double entered from the digital photographs into EpiData version 3.1 (EpiData Association, Odense, Denmark).

A structured questionnaire was used to collect data on the characteristics of the diagnostic centres through interviews of representatives of each centre. Pre-coded responses from the interviews were entered into EpiData, alongside the outcome data on number of suspects from the digital photographs. Data were transferred to and analysed using Stata version 10.1 (Stata Corp, College Station, TX, USA).

Statistical analysis

The outcome (dependent) variable in the analysis was the ratio of female to male suspects at a diagnostic centre (F:M suspect ratio). The explanatory (independent) variables for the analysis were the diagnostic centre characteristics. All of the explanatory variables were binary; for example, diagnostic centres were classified as government (A) or private (B). Explanatory variables for which the majority of observations ($\geqslant$90%) fell into a single category were excluded from the analysis. The unit of analysis in this study was the individual diagnostic centre.

Multiple linear regression modelling was used to study the relationship between each centre level

explanatory variable and the outcome variable while adjusting for the district in which the diagnostic centres are located. Prior to setting up the model, the F:M suspect ratio was transformed using a logarithmic function (log F:M suspects) to make the distribution closer to normal distribution. The assumption of linearity was met for all outcome–explanatory variable pairs.

For each explanatory variable, a linear regression model of log F:M suspects on that centre level explanatory variable was fitted; district was added as a covariate in the simple linear regression model to adjust for differences between districts in which centres are located. The coefficient of variation (R^2) and the regression coefficient were calculated. The coefficient values were transformed prior to reporting to make the results easier to interpret. The transformed coefficients (β) reported in the results represent:

$$\frac{\text{F:M suspect ratio in group A (e.g., government centres)}}{\text{F:M suspect ratio in group B (e.g., private centres)}}$$

A coefficient of 1.5 indicates that the F:M suspect ratio in group A is 50% greater than the F:M suspect ratio in group B. For each transformed regression coefficient, the associated 95% confidence interval (CI) and the two-sided *P* value are reported.

This study was approved by the ethics committee of the London School of Hygiene & Tropical Medicine and the Pakistan NTP.

RESULTS

Of 143 DOTS-reporting diagnostic centres in the 10 districts selected, complete interview data were obtained from 142 and complete outcome data were obtained from 141. The median F:M ratio across all diagnostic centres was 1.06 and the range of observed F:M ratios was 0 to 5. Table 1 summarises the socio-economic characteristics of the districts and the distribution of diagnostic centres and TB suspects across districts.

Table 2 Summary of data collected on diagnostic centre characteristics (binary explanatory variables)

Diagnostic centre characteristic	No. of centres (n = 142)	% of centres
Primary centres	62	43.7
Government centres	114	80.3
Women's departments	92	64.8
Children's departments	47	33.1
Lady health workers linked to centre	74	52.1
Centres located in populated areas	123	86.6
Majority of patients from local area	72	51.0
Majority of patients travel on foot	56	39.7
Open 7 days a week	61	43.0
Opening timings longer than 9 am–2 pm	65	45.8
Sputum collection times longer than 9 am–2 pm*	14	10.0
Free TB diagnosis	76	53.5
Males and females screened together*	129	91.5
Female physicians for female patients*	12	8.5
Laboratory technicians provide sputum instructions*	136	95.8
Physicians for screening tuberculosis suspects*	136	95.8
>5 physicians at the diagnostic centre	51	36
>100 suspects registered in 2008 Q3	51	36

*Not included in the linear regression analysis as most observations (≥90%) fell into a single category.
TB = tuberculosis; Q3 = third quarter.

The survey showed that most diagnostic centres in Pakistan follow a similar diagnostic process (Table 2). TB screening was mostly conducted by doctors (96%), sputum submission instructions were provided by laboratory technicians (96%) and male and female patients were screened together (92%). The majority (80%) of the DOTS-reporting centres surveyed were government-run. Less than half of the diagnostic centres could be visited for clinical screening after 2 pm, which means that working patients need to take time off from work to be diagnosed at those centres.

Of the 13 diagnostic centre characteristics included in the regression analysis, five had a statistically significant association with the F:M suspect ratio at the $P = 0.05$ level (Table 3).

Two centre-level variables were associated with more female suspects relative to males. In diagnostic

Table 1 Socio-economic characteristics and distribution of tuberculosis suspects across districts studied

District (province)	Female population[17] %	Wood or brick houses (household wealth)[18] %	Male literacy[18] %	Female literacy[18] %	DOTS centres (n = 141) n	Male suspects (n = 12 786) n	Female suspects (n = 12 093) n
Quetta (Balochistan)	46	66	80	47	12	310	435
Ziarat (Balochistan)	48	14	66	19	4	19	28
Mansehra (KPK)	50	47	62	33	16	468	638
Batgram (KPK)	49	20	59	15	4	100	183
Kohistan (KPK)	45	18	45	3	4	85	130
Karachi (Sindh)	46	99	83	73	52	6595	5791
Thatta (Sindh)	47	66	48	17	15	485	382
Badin (Sindh)	47	64	55	27	11	610	395
Narowal (Punjab)	50	96	67	47	9	1063	1075
Sialkot (Punjab)	49	98	68	61	16	3051	3036

KPK = Khyber-Pakhtunkhwa.

Table 3 Results of the multiple regression analysis using log female:male suspect ratio as the outcome, adjusting for 'district'

	Adjusted regression coefficient (n = 141)			
Characteristic of diagnostic centre	β value	95%CI	P value	R^2
Primary centre	1.13	0.54–1.35	0.193	0.092
Government centre	0.99	0.79–1.23	0.918	0.053
Women's department present	1.03	0.87–1.23	0.702	0.053
Children's department present	0.93	0.78–1.12	0.428	0.057
Lady health workers linked to centre	0.096	0.08–1.15	0.641	0.054
Located in populated areas	1.10	0.87–1.38	0.407	0.057
Majority of patients from local area	1.32	1.12–1.55	0.001	0.123
Majority of patients travel on foot	1.29	1.10–1.51	0.002	0.111
Open 7 days a week	0.89	0.76–1.05	0.154	0.067
Opening timings longer than 9 am–2 pm	0.85	0.72–1.99	0.041	0.081
Tuberculosis diagnosis free	0.89	0.74–1.07	0.249	0.062
Over 5 physicians at the diagnostic centre	0.82	0.69–0.97	0.019	0.102
Over 100 suspects registered in 2008 Q3	0.80	0.68–0.94	0.008	0.100

CI = confidence interval; Q3 = third quarter.

centres to which the majority of patients travel on foot, the F:M ratio was 29% higher than in those centres to which most patients travel by transport (P = 0.002). In diagnostic centres where the majority of visiting patients live in the local area, the F:M suspect ratio was 32% higher than in centres to which patients travel from neighbouring villages or districts (P = 0.001).

Several of the diagnostic centre characteristics studied were associated with lower numbers of female than male suspects. Diagnostic centres with evening opening hours had an F:M suspect ratio that was 15% lower than centres that followed standard government 9 am to 2 pm working hours (P = 0.041). However, being open 7 days a week was not found to significantly influence the F:M ratio of suspects at a diagnostic centre. In diagnostic centres that registered more than 100 suspects between July and September 2008, indicating a higher suspect burden on the centre, the F:M ratio was 20% lower than in centres that registered fewer patients (P = 0.008). Similarly, in centres with more than five doctors, the F:M ratio was 18% lower than in centres that had fewer doctors (P = 0.019).

Several potentially important characteristics of diagnostic centres, such as whether they are public or private, primary or secondary, the fees for diagnosis and the presence of women's or children's departments, were not found to be associated with the sex ratio of suspects at a diagnostic centre in this study. Regression standardised residuals were approximately normally distributed, and plots indicated that errors were generally homoskedastic.

DISCUSSION

This study identifies characteristics of diagnostic centres that are associated with sex differences in the number of TB suspects registered at the centres. The results indicate that smaller diagnostic centres (in terms of number of suspects registered and number of doctors) and local health centres serving communities living in the immediately vicinity see more female than male suspects. Similarly, diagnostic centres that the majority of patients access on foot also have more female than male suspects compared to centres that require transport by bus, wagon or taxi.

While this is the first study to quantitatively assess the influence of diagnostic centre characteristics on male and female TB suspects' utilisation of health services in Pakistan, the findings are consistent with results from other studies. Studies in Pakistan have reported that women's mobility is restricted,[8,9] and that women more commonly use health services that are closer to their homes.[11,19,20] A study in China also reported that women were more likely to visit lower level, local health facilities, whereas men were more likely to visit larger facilities.[21]

The results suggest that ease of physical access to a diagnostic centre, in terms of distance and transport requirements, may have a stronger effect on increasing the relative number of female suspects at a diagnostic centre than services provided within the centre. Several studies have reported that women have a preference for private health providers and primary health facilities when seeking TB care.[5,6,22] In the present study, neither the type of health facility (government, private, primary, secondary) nor the presence of a specialist women's or children's department was associated with the F:M suspect ratio.

Comparing the sex ratio of TB suspects at facilities open from 9 am to 2 pm vs. those open longer showed that evening opening hours was associated with more male than female suspects. In settings where fewer women undertake formal employment, it is expected that visiting a diagnostic centre during working hours would be more of a barrier to men than women. A study on adherence to TB treatment in Pakistan also suggested that opportunity costs for patients influenced attendance of health centres, with

economically inactive groups being more willing to visit health centres.[23] Loss of income as a major fear specific to men seeking TB care has also been reported in Viet Nam.[24]

Being open 7 days a week had no significant effect on the F:M suspect ratio. This suggests that being able to visit health facilities during the weekend does not attract more male suspects in the same way as being able to visit health facilities in the evenings. A possible explanation is that a large proportion of men utilising these TB services are daily wage earners. In this working arrangement, any days that are not worked contribute to loss of income. Centres that are open 7 days a week, but only during working hours, would therefore not provide increased convenience of access to males working as daily wage earners.

Centres providing TB diagnosis completely free of charge did not have a significantly different F:M suspect ratio than those that imposed a charge for diagnosis. In other studies, higher costs have been found to deter male patients in particular.[14,24] One explanation for the lack of difference in outcome between 'free' and 'charging' diagnostic centres is that the majority of government centres that charge for diagnosis impose only a minor registration fee for administration. Patients may therefore not consider this a substantial fee for TB diagnosis, as any tests or medications for TB would be free.

Unlike most other studies conducted in Pakistan, in this study diagnostic centres from districts across all four provinces were included to increase the generalisability of the results to the whole country. Generalisability of the findings was maximised by using random selection of districts wherever possible and by sampling at least two districts from each province. However, as discussed earlier, security risks meant that purposive selection had to be used in KPK and Balochistan. It is recognised that results from the diagnostic centres in these two provinces run the risk of suffering from selection bias and may be less generalisable than those obtained from districts in Punjab and Sindh.

The main advantage of using interviews of centre representatives to collect data was that data could be collected from a large number of diagnostic centres in a relatively short period of time and in a cost-effective manner. This allowed all centres from a district to be included in the study rather than having to sample a proportion. A limitation of this approach is that some potential centre-level explanatory variables could not be assessed accurately through the interviews. For example, factors related to the quality of services provided at diagnostic centres, such as quality of doctors' screening of male and female TB suspects and patient waiting time, could not be accurately assessed using this methodology. It should also be considered that there may be respondent bias in the assessment of certain variables such as the reported opening times.

Future studies using non-participant observations through visits of diagnostic centres would be useful in assessing variables that cannot be captured through interviews of diagnostic centre representatives; these may be more expensive to conduct, however, and may be limited to a smaller sample size.

CONCLUSIONS AND RECOMMENDATIONS

In Pakistan and elsewhere, the number of male TB suspects going through the DOTS reporting system, rather than to alternative providers, may be improved by offering TB screening after working hours in selected DOTS reporting centres. To enhance case detection and access to TB care for women, it is particularly important that local health facilities are well-functioning and equipped for TB diagnosis. This is likely to be applicable to Pakistan and other countries where women's mobility is restricted. Low cost, low technology interventions that can be implemented at the local health facility may be more effective in reaching women than interventions located in a few centralised hospitals. From a gender point of view, geographic equity of health care is especially important in countries such as Pakistan where more women than men use smaller local health facilities.

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RÉSUMÉ

CONTEXTE : Les centres de diagnostic appliquant la stratégie DOTS au Pakistan.

OBJECTIFS : Investiguer de manière quantitative l'influence des caractéristiques du centre de diagnostic sur le nombre de suspects de la tuberculose (TB), hommes et femmes, enregistrés dans les centres de diagnostic.

SCHÉMA : On a sélectionné 10 districts dans quatre provinces du Pakistan et on a colligé les données sur les suspects de TB, hommes et femmes, dans tous les centres de diagnostic au sein de chaque district. Les données sur les caractéristiques des centres de diagnostic ont été colligées au moyen d'un questionnaire structuré. Une analyse de régression multiple linéaire a été menée pour évaluer l'influence de chaque caractéristique sur les différences en nombre de suspects en fonction du sexe.

RÉSULTATS : Deux caractéristiques des centres de diagnostic ont été en association avec des nombres plus élevés de femmes que d'hommes comme suspects TB enregistrés : approvisionnement dans la zone locale de couverture ($P = 0{,}001$) et accessibilité à pied ($P = 0{,}002$). Les caractéristiques suivantes ont été en association avec des nombres plus élevés de suspects masculins plutôt que féminins : ouverture après 14 h de l'après-midi ($P = 0{,}041$), présence de plus de cinq médecins au centre ($P = 0{,}019$), et enregistrement de plus de 100 suspects par trimestre ($P = 0{,}008$).

CONCLUSIONS : Les plus petits centres de diagnostic locaux qui sont accessibles à pied ont enregistré des nombres plus élevés de suspects féminins que masculins. Les services plus centralisés qui sont plus loin des domiciles, les services plus importants et ceux ayant des heures d'ouverture plus tardives enregistrent un nombre plus élevé de suspects masculins que féminins.

RESUMEN

MARCO DE REFERENCIA: Los centros de diagnóstico de la tuberculosis (TB) que aplican la estrategia DOTS en Pakistán.

OBJETIVOS: Realizar una investigación cuantitativa de la influencia de las características del centro sobre el número de hombres y mujeres que se registraron con presunción diagnóstica de TB en los centros de diagnóstico de la TB.

MÉTODO: Se escogieron 10 distritos de las cuatro provincias de Pakistán y se recogieron datos sobre los casos con presunción diagnóstica de TB en hombres y en mujeres en todos los centros diagnósticos del distrito. Se obtuvo información sobre las características de los centros mediante un cuestionario estructurado. Se llevó a cabo un análisis de regresión linear multifactorial, a fin de evaluar la influencia de cada característica sobre las diferencias entre los sexos con respecto al número de casos presuntos.

RESULTADOS: Dos características de los centros se asociaron con un número superior de mujeres en los casos registrados con presunción de TB: los centros cuyos usuarios viven en la zona de influencia ($P = 0{,}001$) y los centros cuyos usuarios acuden a pie ($P = 0{,}002$). Las siguientes características se asociaron con un mayor número de hombres en los casos con presunción de TB: los centros que operan después de las dos de la tarde ($P = 0{,}041$), los centros donde trabajan más de cinco médicos ($P = 0{,}019$) y los centros donde se registran más de 100 casos presuntos por trimestre ($P = 0{,}008$).

CONCLUSIONES: Los centros locales más pequeños, accesibles a pie, registraron más casos presuntos de TB de mujeres que de hombres. Los centros más centralizados, más alejados de los hogares, de mayor tamaño y con horarios de atención más tardíos registraron una proporción mayor de hombres con presunción de TB.