European Journal of Epidemiology (2005) 20: 729–734
DOI 10.1007/s10654-005-0615-9

INFECTIOUS DISEASES

Deprivation, immigration and tuberculosis incidence in Naples, 1996–2000

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Accepted in revised form 6 June 2005

Abstract. Most of the tuberculosis cases in Campania occur in Naples, the biggest city in the South of Italy with the highest unemployment and immigration rates. However, the occurrence of tuberculosis differs between the different neighbourhoods and it is not known whether these differences are associated with poverty or with immigration. We describe tuberculosis incidence and its association with socio-economic status and immigration in the city of Naples during the period 1996–2000. The basic design was an ecological study, correlating the incidence of tuberculosis which was calculated on the basis of notified tuberculosis cases to census data on immigration and socio-economic deprivation per neighbourhood. Immigrants had a high risk for tuberculosis (RR = 34 for Africans) but the incidence of TB varied largely by districts and seemed independent of immigration. All socioeconomic factors increased the incidence of TB significantly. In a multivariate Poisson regression analysis only the rate of unemployment ($p = 0.02$) and the population density ($p = 0.002$) remained independently associated with tuberculosis incidence. In this study we showed that deprivation explained differences in tuberculosis incidence in Naples to a greater extent than immigration.

Key words: Tuberculosis incidence, immigration, indices of socioeconomic deprivation

Introduction

Since the 1980s Tuberculosis (TB) notifications have increased in developed countries. This has been attributed to several causes: the HIV/AIDS epidemic, migration from countries where TB is more frequent, multidrug resistance and intravenous drug use [1]. In addition, TB occurrence is associated with indices of socio-economic deprivation such as overcrowding, unemployment, education, homelessness and poor nutrition [2].

The overall incidence of TB in Italy decreased between the 1960s and 1980s but subsequently increased from 5.8 in 1980 to 9 per 100,000 in 1999 [3–5]. Therefore, TB was included as a disease to be reported through the National Communicable Diseases Reporting System in 1996 [4–7]. By law physicians should notify all suspected and defined cases of TB to the Local Health Unit. This unit subsequently needs to ascertain the diagnosis since only confirmed TB cases can be notified to the Regional Health Authority and from there to the Ministry of Health and National Institute of Statistics (ISTAT) [6, 8].

Tuberculosis notification data from the Italian Ministry of Health show that incidence rates in the North of Italy decreased from 11 per 100,000 in 1990 to 9 per 100,000 population in 1999, whilst the trend in the South was the opposite with an increase from a low of 2 per 100,000 in 1990 to 5 per 100,000 population in 1999 [9].

Campania is the most populated southern region of Italy and the notification rate data show that the majority of tuberculosis cases in Campania occur in Naples (Figure 1). Among the Italian cities, Naples has the highest population density and the highest percentage of unemployed people with respect to the active population (42%). Also the immigration rate is relatively high: community data of Naples report on a total of 13,783 foreign-born citizens, but the number of immigrants has been estimated to be more than 16,000 (20% illegal immigrants).

In the present study we aimed to evaluate TB incidence and its association with socio-economic deprivation and immigration in the city of Naples.

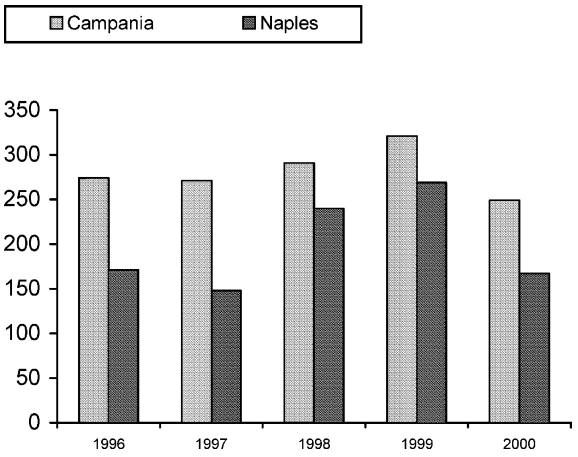

Figure 1. Number of Tuberculosis cases notified in the Campania region and those notified in Naples during 1996 to 2000.

Methods

Setting

Between 1996 and 2000, the ASL NA 1 (the local health agency of the city of Naples) received 868 ascertained notifications of tuberculosis (incident culture positive or CDC defined cases). This local health agency provides health to 10 districts (no. 43–52) comprising the thirty neighbourhoods that historically make up the urban area of Naples.

Since our aim was to evaluate TB incidence and its association with socio-economic deprivation and immigration in the city of Naples, subjects who did not reside in the urban area of Naples and were not registered to ASL NA1 (n = 518), were excluded from our study, leaving 350 persons for our analyses.

For each TB case we had information on gender, age, the health district and neighbourhood of residence, country of birth (immigration) and clinical characteristics regarding tuberculosis infection. Moreover, from the 1991 census data (the most recent available) we obtained the population size per neighbourhood and indicators of socio-economic deprivation for each neighbourhood such as the median number of persons per household, the number of persons per square kilometre (density) (both overcrowding variables), the percentage of unemployed persons (unemployment), and the percentage of illiterate persons (education) (Table 1). Data on country of birth of citizens by health district were obtained from the ISTAT regarding the year 2000.

Analysis

We used a three-step approach to explore whether immigration and indices of socio-economic deprivation might have influenced the occurrence of TB in Naples. First we calculated the incidence rate of TB per calendar year to observe trends in the incidence. Secondly, we estimated the incidence of TB by gender, age, occupation, country of origin and district. Since a large heterogeneity in TB incidence was observed between health districts a third analysis was conducted on neighbourhood level, which allowed for a further exploration of the role of socio-economic factors in TB incidence. Country of origin and being in prison are important risk factors for TB and should be controlled for when looking at the effect of socio-economic factors, which may have a much smaller association. However, no public denominator data were available on immigrants per district or neighbourhood, which prohibited us from being able to control adequately for country of origin when looking at the effect of socio-economic factors.

Table 1. Characteristics of ascertained tuberculosis cases

	No.	%
Gender		
Males	268	76.6
Females	82	23.4
Age (median, IQR)	44 (17–71)	
Year		
1996	83	23.7
1997	76	21.7
1998	76	21.7
1999	68	19.4
2000	47	13.4
Profession		
Retired	67	19.1
Unemployed	67	19.1
Not specified	57	16.3
Housewife	36	10.3
Blue collar worker	30	8.6
White collar worker	47	13.4
Prisoner	15	4.3
Other not at risk	11	3.1
Student	9	2.6
Nurse/paramedic	6	1.7
Not classified	5	1.4
Continent of origin		
Italian	300	85.7
Africa	33	9.4
South Asia	6	1.7
South America	6	1.7
East Europe	5	1.4
Australia	0	0
AFB* smear		
Positive smear	157	52.3
Negative	83	27.6
Unknown	60	20.0
Etiology (culture)		
MTB	193	55.1
Untyped	47	13.4
Unknown	110	31.4
Type of infection		
Pulmonary	300	85.7
Extra-pulmonary	50	14.3

*Acid Fast Bacilli.

As a measure to control for potential confounding, we restricted the neighbourhood analysis to native Italian tuberculosis cases (rather than adjusting for country of origin) who were not in prison (n = 10). Due to lack of adequate denominator data we could not delete non-native Italians from the denominator but they are only a small proportion of the counted population (1–1.5%) and therefore may not affect further analyses. Multivariate Poisson regression was applied to assess the association between socio-economic factors and TB incidence.

Results

The city of Naples comprised an average of 1,029,164 persons during the study period. In the period 1996–2000 350 ascertained TB cases, residing in Naples were notified to the health agency. The median age of the tuberculosis cases was 44 years and the large majority was male (76.6%) (Table 1). A relatively large proportion of cases was unemployed (19.1%) or resided in prison (4.3%) and the majority were native Italians (85.7%). Among foreign-born cases the proportion of Africans was the largest. The proportion of foreign-born cases increased substantially over calendar time (Figure 2).

The overall incidence of ascertained TB was 7.0 per 100,000 population. The incidence rate was 3.5-fold higher in males than in females, with respect to non-active persons (retired), both occupied and unemployed persons had a 2-fold higher risk of TB (Table 2). Large differences in TB incidence between native Italians and foreign born immigrants (relative risk up to 34 for Africans) were observed (Table 2).

The analysis by health districts showed that TB incidence was higher in health districts 53, 50 and 48 (RR 5.36, 3.63 and 2.53 respectively), which could not be explained by the immigrant cases as these were only a relatively small proportion of the total number of cases (except for districts 51 and 53). Indeed, Table 3 shows that differences in incidence between health districts are maintained upon exclusion of immigrants from the cases.

To further explore potential socio-economic related causes of the differences in incidence among native Italians we divided the health districts in smaller (more homogeneous) neighbourhoods (Table 4). An increasing population density ($p = 0.01$), higher rate of illiteracy ($p = 0.01$) and higher rate of unemployment ($p = 0.006$) (Figure 3) increased the incidence of TB significantly. The incidence decreased upon a larger average number of rooms per house, but this association was not significant ($p = 0.11$). In a multivariate Poisson regression analysis only the rate of unemployment (increase of 5% in TB incidence with 1% increase in unemployment, $p = 0.02$) and the population density ($p = 0.002$) remained independently associated with the incidence of TB after inclusion of all covariates.

Discussion

In this study we found a significant association between indices of socio-economic deprivation and the incidence of TB in Naples. In addition, we showed that the number of immigrant cases increases but is still small in relative terms and unable to explain differences in the incidence of TB per neighbourhood.

TB incidence was higher in males and elderly, which is in line with our expectations [9]. Although the transmission of TB has declined in developed countries, the higher disease rate in elderly is due to

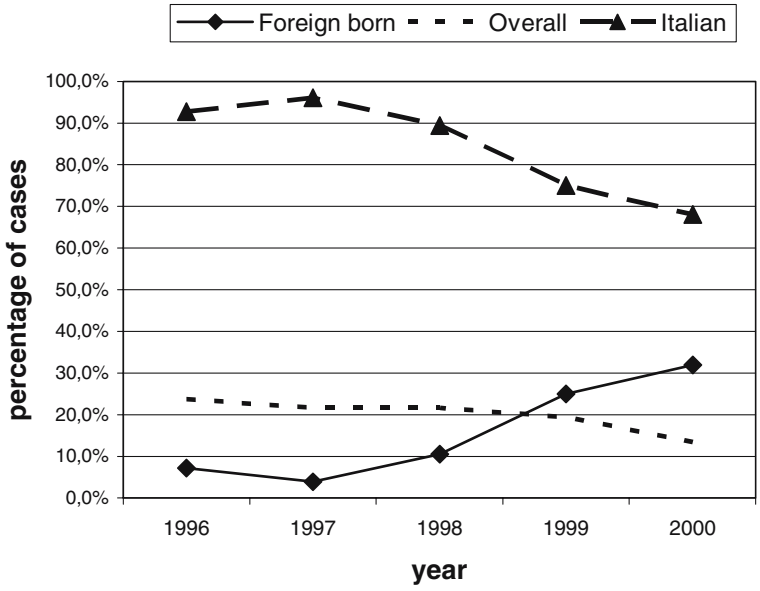

Figure 2. Change in reported tuberculosis cases over calendar time.

Table 2. Incidence of tuberculosis 1996–2000 in Naples

	Cases (%)	Persontime (PY)	Incidence per 100,000 person years	RR	95% CI
Gender					
Male	268	2,470,710	10.8	3.54	2.76–4.53
Female	82	2,675,110	3.1	Reference	
Age					
0–14	8	1,023,470	0.8	0.28	0.13–0.60
15–24	29	1,024,845	2.8	Reference	
25–64	259	2,647,020	9.8	3.2	2.36–5.08
≥65	54	641,500	8.4	3.3	1.89–4.67
Country of origin					
Italian	300	5,072,490	5.9	Reference	
East Europe	5	19,375	20.6	3.49	1.30–9.36
Africa	33	15,845	202.0	34.2	23.2–49.2
South-America	6	26,505	15.1	9.24	4.12–20.7
South-Asia	6	10,985	54.6	2.55	0.95–6.84
Australia	0	620	0.0		
Occupation					
active occupied	99	1,239,045	8.0	2.08	1.60–2.69
unemployed	67	896,830	7.5	1.94	1.45–2.60
not active	136	3,534,445	3.8	Reference	
District*					
44	16 (4)	455,845	3.5	1.08	0.57–2.08
45	27 (1)	559,235	4.8	1.49	0.84–2.63
46	25 (5)	505,120	4.9	1.53	1.86–2.73
47	21 (3)	648,205	3.2	Reference	
48	38 (1)	463,710	8.2	2.53	1.49–4.31
49	35 (4)	534,590	6.5	2.02	1.18–3.47
50	53 (1)	450,785	11.8	3.63	2.19–6.02
51	32 (10)	474,490	6.7	2.08	1.20–3.61
52	22 (1)	586,715	3.7	1.18	0.64–2.10
53	81 (20)	466,625	17.4	5.36	3.32–8.66
Total	350 (50)				

*In brackets is indicated the number of immigrants in the respective districts.

reactivation of an earlier infection that appears due to a decline in immune defence [9, 10].

We showed a strong association between immigration from Africa and south Asia and TB incidence, but due to the small number they could not explain the differences in incidence per neighbourhood. The fact however, that the percentage of foreign-born cases is increasing rapidly asks for pro-active interventions. Previous studies have shown that immigration may be a potential confounder of the association between deprivation and TB. Immigrants are usually younger and live in the poorest areas [11, 12]. On the basis of these considerations and the lack of data to adequately adjust for this confounder (due to the lack of exact denominator data on immigrants), we chose to exclude immigrants from the numerator. By doing so socio-economic deprivation factors remained associated with TB

Table 3. incidence of tuberculosis by district in Naples 1996–2000 without immigrants

District	Cases	Persontime	Incidence per 100,000 person years	RR	95% CI
44	12	455,845	2.6	0.95	0.46–1.97
45	26	559,235	4.6	1.67	0.92–3.05
46	20	505,120	4.0	1.43	0.75–2.70
47	18	648,205	2.8	1 (ref)	
48	37	463,710	8.0	2.87	1.64–5.05
49	31	534,590	5.8	2.09	1.35–4.30
50	52	450,785	11.5	4.15	2.43–7.10
51	22	474,490	4.6	1.67	0.90–3.11
52	21	586,715	3.6	1.29	0.69–2.42
53	61	466,625	13.1	4.71	2.78–7.96

Table 4. Incidence of tuberculosis in different neighbourhoods of Naples excluding immigrants (n = 50) and prisoners (n = 10)

Neighbourhood	Cases	Personyears	Incidence rate per 100,000 PY	Unemployment rate	Density per km^2
S.Ferdinando	5	103,035	4.9	39.5	22,399
Chiaia	2	226,845	0.9	25.0	16,741
Posillipo	5	126,850	3.9	21.4	4907
Bagnoli	6	133,790	4.5	42.2	3362
Fuorigrotta	15	432,815	3.5	37.3	13,962
Soccavo	13	260,250	5.0	45.7	10,186
Pianura	8	269,815	3.0	43.7	4713
Vomero	11	262,170	4.2	24.2	24,163
Arenella	13	407,230	3.2	26.7	15,514
Piscinola	15	141,710	10.6	56.0	7984
Chiaiano	9	109,150	8.3	41.5	2257
Scampia	23	219,900	10.5	61.7	10,397
Stella	19	157,815	12.0	47.2	16,879
San Carlo all'Arena	12	405,395	3.0	40.3	10,612
Miano	11	137,705	8.0	59.8	14,728
Secondigliano	13	257,025	5.1	55.7	17,485
S.P. Paterno	9	86,085	10.5	54.8	3159
Mercato	3	52,885	5.7	53.0	27,121
Pendino	4	83,800	4.8	50.6	26,603
Avvocata	5	184,770	2.7	37.4	30,290
Monte Calvario	3	120,580	2.5	46.4	32,155
San Giuseppe	2	29,655	6.7	28.5	13,793
Porto	3	24,715	12.1	34.3	4336
Ponticelli	6	258,850	2.3	53.3	5683
Barra	9	207,455	4.3	53.7	5306
San Giovanni a Teduccio	8	136,570	5.9	56.0	11,623
San Lorenzo	44	264,310	16.7	48.3	37,227
Vicaria	6	83,125	7.2	42.2	23,090
Poggioreale	6	117,685	5.1	47.0	5289
Zona Industriale	2	34,840	5.7	45.9	2600

*7 prisoners in Secondigliano and 3 prisoners in Poggioreale. Since some neighbourhoods are part of more than one district, data are organized by neighbourhood only.

incidence, and the most important independent risk factors were the rate of unemployment ($p = 0.02$) and the population density ($p = 0.002$). A high population density points to over-crowding which increases the probability to be exposed to M. tuberculosis because of a greater degree of shared airspace [11, 13–15]. However, if TB in native, especially in elderly people, is more determined by the reactivation of a latent infection than a new transmission, the relationship with crowding is less obvious [11, 16, 17]. This seems to be true for our population in whom elderly people are more afflicted. Unemployment, that as individual measure may be subject to less error [18, 19], was independently associated with an increase in TB incidence. Nevertheless, other studies have reported contradicting results on the association between unemployment and TB [11, 20]. Conclusions about cause-effect relation derived from ecological studies should therefore be interpreted with caution [14, 15, 21]. Further limitations of this study are the lack of updated census data, which may have diluted the association between socio-economic deprivation

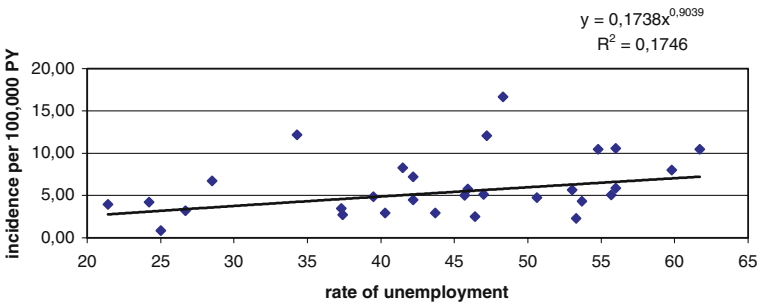

Figure 3. Incidence by rate of unemployment.

factors and TB incidence, the potential for under-notification of TB that may have resulted in a underestimate of the incidence and the lack of data on the origin of immigrants in the various residential zones. However, we tried to control for potential confounders by using stratifications and multivariate analysis and excluding immigrants and the fact that a close association between TB rates and various factors of socioeconomic deprivation was found, suggests that the method we used was reliable enough.

In conclusion, our study supports the hypothesis that factors of socio-economic deprivation contribute to neighbourhood differences in TB incidence in Naples. Neighbourhoods with worse socio-economic deprivation had a greater TB incidence rate than neighbourhoods with a higher socio-economic level. However, the increasing percentage of foreign born cases in Naples cannot be denied suggesting that immigration may influence TB incidence in the future. Although measures like contact tracing and campaigns to educate people on early clinical presentation of TB are really important to reduce notification rates, it is unlikely that TB incidence can be decreased in deprived areas without improving the socio-economic factors in this population.

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