City Research Online

City St George's, University of London

Citation: Donisi, V., Jones, J., Pertile, R., Salazzari, D., Grigoletti, L., Tansella, M. & Amaddeo, F. (2011). The difficult task of predicting the costs of community-based mental health care. A comprehensive case register study.. Epidemiology & Psychiatric Sciences, 20(3), pp. 245-256. doi: 10.1017/s2045796011000473

This is the unspecified version of the paper.

This version of the publication may differ from the final published version. To cite this item please consult the publisher's version.

Permanent repository link: https://openaccess.city.ac.uk/id/eprint/450/

Link to published version: https://doi.org/10.1017/s2045796011000473

Copyright and Reuse: Copyright and Moral Rights remain with the author(s) and/or copyright holders. Copies of full items can be used for personal research or study, educational, or not-for-profit purposes without prior permission or charge, unless otherwise indicated, provided that the authors, title and full bibliographic details are credited, a hyperlink and/or URL is given for the original metadata page and the content is not changed in any way. For full details of reuse please refer to City Research Online policy.

City Research Online: http://openaccess.city.ac.uk/ publications@citystgeorges.ac.uk

Epidemiology and Psychiatric Sciences, page 1 of 12. © Cambridge University Press 2011
doi:10.1017/S2045796011000473

ORIGINAL ARTICLE

The difficult task of predicting the costs of community-based mental health care. A comprehensive case register study

V. Donisi[1]*, J. Jones[2], R. Pertile[1], D. Salazzari[1], L. Grigoletti[1], M. Tansella[1] and F. Amaddeo[1]

[1] *Section of Psychiatry and Clinical Psychology, Department of Public Health and Community Medicine, University of Verona, Verona, Italy*
[2] *Department of Mental Health and Learning Disability, City University, London, UK*

Background. Previous studies have attempted to forecast the costs of mental health care, using clinical and individual variables; the inclusion of ecological measures could improve the knowledge of predictors of psychiatric service utilisation and costs to support clinical and strategic decision-making.

Methods. Using a Psychiatric Case Register (PCR), all patients with an ICD-10 psychiatric diagnosis, who had at least one contact with community-based psychiatric services in the Verona Health District, Northern Italy, were included in the study ($N = 4558$). For each patient, one year's total cost of care was calculated by merging service contact data with unit cost estimates and clinical and socio-demographic variables were collected. A socio-economic status (SES) index was developed, as a proxy of deprivation, using census data. Multilevel multiple regression models, considering socio-demographic and clinical characteristics of patients as well as socioeconomic local characteristics, were estimated to predict costs.

Results. The mean annual cost for all patients was 2,606.11 Euros; patients with an ongoing episode of care and with psychosis presented higher mean costs. Previous psychiatric history represented the most significant predictor of cost (36.99% R^2 increase) and diagnosis was also a significant predictor but explained only 4.96% of cost variance. Psychiatric costs were uniform throughout the Verona Health District and SES characteristics alone contributed towards less than 1% of the cost variance.

Conclusions. For all patients of community-based psychiatric services, a comprehensive model, including both patients' individual characteristics and socioeconomic local status, was able to predict 43% of variance in costs of care.

Received 23 March 2011; Revised 4 May 2011; Accepted 5 May 2011

Key words: case register study, cost prediction, costs of community care, socioeconomic status.

Introduction

There is growing recognition of the need for economic analysis to support clinical and strategic decision-making around the allocation of limited resources to mental health care (McDaid *et al.* 2006; Grigoletti *et al.* 2010). Previous studies have demonstrated the usefulness of exploring the relationship between patients' characteristics, previous service utilisation and the economic costs of mental health care. Psychiatric history appears to be a good predictor of costs; a number of studies have demonstrated that patients with a long history of contact with services present higher costs (Amaddeo *et al.* 1997; Beecham *et al.* 1997; McCrone *et al.* 1998). A cross-national study conducted in five European countries, investigating patterns and costs of care for patients with schizophrenia, found that higher needs, greater symptom severity and longer psychiatric history were associated with higher costs (Knapp *et al.* 2002). A recent study conducted on a large sample of patients receiving psychiatric care in a Spanish Hospital found that mental health care costs were not evenly distributed throughout the patient population, and that early onset of the mental disorder, permanent disability, organic mental disorders, substance-related disorders, psychotic disorders and some external factors, such as variables related to socio-economic and psychosocial circumstances, were associated with higher costs (Baca-Garcia *et al.* 2008).

A recent review of cost prediction studies in the mental health field by Jones and colleagues (Jones *et al.* 2007) found that a single variable alone cannot predict costs. However, the review highlighted that

* Address for correspondence: Dr V. Donisi, Ph.D., Psychologist, Section of Psychiatry and Clinical Psychology, Department of Public Health and Community Medicine, University of Verona, Policlinico G.B. Rossi, Piazzale L.A. Scuro 10, 37134 Verona, Italy.
(Email: valeria.donisi@univr.it)

clinical factors, such as diagnosis, alongside with other individual's personal characteristics, such as gender and age, and previous use of psychiatric services, can explain the variations in costs between patients. In an Israeli study, a model based on age, diagnosis and previous 5 years of psychiatric hospital utilisation explained 93% of the variation in cost for hospital and day-care utilisation (Ginsberg *et al.* 1997), although the majority of the studies reviewed explained only 25–50% of the total variations in costs. The review concluded that the inclusion of ecological measures in predictive models, such as socio-economic status (SES), the geographical characteristics and social cohesion of areas where patients live, may further explain the variation in mental health care costs.

There are now a few studies that have broadened their scope and incorporated ecological and social factors into the exploration of factors that may influence service utilisation and the costs of mental health care. Research conducted in London and New York City (Curtis *et al.* 2006) found that several groups of ecological factors, including poverty and socio-economic deprivation, social fragmentation, high concentrations of minority ethnic groups and close spatial proximity to the services, are variables positively associated with higher levels of psychiatric hospital use. In Sweden, Tiainen *et al.* (2008) found that urbanisation, gender, age and number of immigrants all contributed to differences in direct psychiatric costs aggregated and analysed at the county level per capita. Drukker *et al.* (2007) reported that, after controlling for individual SES, there is evidence for an association between neighbourhood SES and objective as well as subjective mental health.

A previous case register study conducted in South Verona, Italy, found that previous psychiatric history was the best predictor of future costs of care (Mirandola *et al.* 2004). First-ever patients and patients with a new episode of care after 3 years of no contact were less costly than patients with an ongoing episode and patients having a new episode after less than 3 years of no contact. The regression models based on socio-demographic variables, diagnosis and previous psychiatric history accounted for 71% of the variation in costs within patients with an ongoing episode, although a very low cost explained that variation resulted for a first-ever patient or a patient with a reopened episode of care. Regarding socio-economic variables, in the same study area Tansella *et al.* (1993) and Thornicroft *et al.* (1993) demonstrated an inverse association between SES and service utilisation, but only for patients with psychosis. A subsequent study (Tello *et al.* 2005*a*) showed that for patients with a previous psychiatric history there was an inverse association between the SES of the geographical area where patients live and their community-based psychiatric services utilisation. So patients with a previous psychiatric history, living in more deprived areas of South Verona, were making greater use of the psychiatric services.

The present study incorporated all explicative variables previously considered in multilevel analysis and considered a larger sample of patients, from a larger geographical area than previous studies (Tansella *et al.* 1993; Thornicroft *et al.* 1993; Tello *et al.* 2005*a*), who had contacts with different types of services in a community mental health system. The study area incorporates the Verona Health District and is characterised by different socio-demographic, economic and geo-morphological patterns.

The aims of this study were therefore twofold: firstly to estimate in a larger sample, including all patients living in a large area in Northern Italy, who received psychiatric care over a one-year period, the costs of patients' care on the basis of their history of previous service utilisation and SES; and secondly to evaluate the performance of various multilevel regression models to predict the psychiatric care expenditure. The hypothesis was that a wide and comprehensive model including both individual and ecological variables, applied in an area with wider socio-economic differences, should enable the prediction of a higher percentage of variance in costs.

Method

The Verona Health District and the Psychiatric Case Register (PCR)

This study was conducted in the Verona Health District that is composed of four mental health service geographical catchment areas in the northeast of Italy. In terms of mental health-care provision, each catchment area includes a 15-bed acute inpatient ward, a Community Mental Health Centre (CMHC) providing day care and rehabilitation, Outpatient Clinics, which provide (limited hours) emergency and continuing care and scheduled domiciliary visits, a liaison service that provides psychiatric and psychological consultations for other departments of the general hospital, a 24-hour Emergency department and Sheltered accommodation. In terms of geographical characteristics, the population served by the Verona Health District is approximately 460 000 (ISTAT, 2001). As described in Zulian *et al.* (2011), the Verona Health District incorporates the city of Verona (250 000 inhabitants) and 35 smaller municipalities that presented different socio-economic characteristics: moving from the intensive rural model and industrial context of the southeast (where South Verona catchment areas

are located) to the extensive rural pattern of the mountain municipalities of the north.

For this study, patients' data were retrieved from the Verona Department Information System, an extension to the Verona Health District of the South Verona PCR. At first contact with any psychiatric service located in the Verona Health District, socio-demographic information, past psychiatric and medical history and clinical data are routinely collected in the PCR for all people aged 14 years and above. All contacts with psychiatrists, psychologists, social workers and psychiatric nurses are recorded, with each attendance at an Outpatient Clinic and each domiciliary visit also counted as a contact.

More information on the South Verona PCR and on the research setting can be found elsewhere (Tansella *et al.* 2006).

Patients

All patients with an ICD-10 psychiatric diagnosis (WHO, 1992), who had at least one contact with the psychiatric services in 2002, were included in the study. The patients were divided into four groups on the basis of their previous service utilisation, using the same criteria as Mirandola *et al.* (2004): (a) *first-ever patients* (patients at their first lifetime contact with a mental health service); (b) *patients with an ongoing episode of care* (patients with previous psychiatric history and with a contact within a 90-day period before the index contact); (c) *patients having a new episode*, after an interval with no contacts between 3 months and 3 years after the latest contact (91–1095 days); (d) *patients having a new episode, after an interval longer than 3 years* (1096 days and more). These criteria were chosen on clinical grounds and according to previous PCR studies in which an episode of care is considered closed or interrupted when a gap of more than 90 days without psychiatric contact occurred (Tansella *et al.* 1995). Clinical and socio-demographic variables were collected and patients' contact with services was followed for one year, from their first contact in the research period, to calculate their service utilisation and subsequently the costs of care provided.

SES index

An SES index was used, as a proxy of deprivation, to evaluate its usefulness in predicting costs of psychiatric care. The SES index was developed and validated by our research unit (Tello *et al.* 2005*b*) in a previous study using data from the 1991 Italian National Census.

This SES index is composed of nine census variables:

- individuals married,
- individuals separated or divorced or widowed,
- single-parent families,
- individuals with elementary school level,
- individuals with a university qualification,
- living in rented accommodation,
- people employed in the industry sector,
- civil servants or people employed in the tertiary sector and
- unemployment rate.

Variables *individuals married, individuals separated or divorced or widowed, individuals with elementary school level, individuals with a university qualification, people employed in the industry sector, civil servants or people employed in the tertiary sector* represent the proportion of the resident population with the condition (married, separated or divorced or widowed, etc.) in each Census Block (CB). Variable *single-parent families* represents the number of resident families with this condition divided by the total number of resident families in each CB. Variable *living in rented accommodation* represents the number of rented accommodations divided by the total number of accommodations in each CB.

The CB is the smallest unit of analysis available from the Italian Census, which allows for anonymity, confidentiality and analysis stability (the mean number of inhabitants per CB was 148).

In the present study, the same Census variables were used, but the data source available was the most recent 2001 Italian Census data available.

The PCR data were drawn from the whole of the Verona Health District catchment area (460 000 inhabitants). A factor analysis was conducted on the nine selected variables, and four factors were selected according to the eigenvalues and screen plot. The SES index was then constructed by adding algebraically the variables' *loadings* for each factor multiplied by the corresponding value/proportion for each of the nine variables. The variables' *loadings* were calculated on whole national data. This procedure was followed for each CB. The resulting score distribution (i.e. continuous SES index) was then divided into four SES groups, identified at the 20th, 50th and the 80th percentiles (i.e. discrete SES index). The four SES groups ranged from SES 1-affluent to SES IV-deprived. Patients' addresses were geocoded using EGON software Release 3.0 (Egon, 2009). Each geocoded patient was linked to a specific SES score through his or her own CB of residence.

Cost estimate method

The total cost of care per patient was calculated by merging individual patients' service utilisation data with unit cost estimates, taken from a unit cost list. This unit cost list includes all psychiatric services

available within the catchment area as well as non-psychiatric medical services, criminal justice services and care provided by non-profit organisations (Amaddeo *et al.* 1995). Costs were calculated in Euros. For each patient, costs were grouped by service functional components: inpatient care costs (which included total days spent in a public or private sector hospital for psychiatric care); sheltered accommodation costs (which included total days spent in public sector specialised accommodation); day-patient care costs (all contacts at day hospitals or at rehabilitation groups); outpatient care costs (all contacts at the outpatient department and community psychiatric clinics, general hospital liaison and accident and emergency departments); community care costs (which included all visits to patients' or relatives' homes, visits to patients temporarily registered with other agencies, or visits to the premises of voluntary organisations and social services by psychiatrists, nurses, psychologists, social workers and other psychiatric staff). The costs of general practitioners (GPs), private psychiatrists and psychologists, other medical care and all indirect costs were not included (Amaddeo *et al.* 1997).

Statistical analysis

Descriptive analyses and multivariate analysis were performed using the STATA software 9.0 (Stata Corporation, 2005). Descriptive statistics included means and standard deviations of the costs for each patient group and for all patients in total, and observed frequencies and percentages summarising socio-demographic characteristics, again by patient group and all patients. A hierarchical (multilevel) multiple regression model was estimated for: (1) each group of patients, (2) all patients together and (3) patients divided into psychosis and non-psychosis diagnostic groups. Psychosis diagnostic groups included schizophrenia and related disorders (ICD-10 codes F20 to F29 and F84) and severe affective disorders (ICD-10 codes F30, F31, F32.3, F33.3, F38.00.8 and F39), while all other diagnoses were included in the non-psychosis diagnostic group. The first level of these models was represented by the patients and the second one by the CBs. The dependent variable was always the total cost of care per patient in Euros, the independent variables were SES index, socio-demographic and clinical patient's characteristics. The socio-demographic characteristics used for the SES Index calculation were not taken into account for the hierarchical models to avoid intercorrelation among predictors. Socio-demographic variables tested as predictors were: gender, age, living situation and occupational status. Patients' previous psychiatric history was evaluated through the number of days spent in hospital in the previous year, admissions in previous year, day-care contacts in the previous year, outpatient contacts in the previous year, community care contacts in the previous year and sheltered accommodation contacts in the previous year.

Multilevel analysis provides a powerful means to model data simultaneously at the levels of the individual and the CB. The adjusted R^2 gives information about the overall costs variance explained from the model. The overall explained variance can be subdivided into between variance and within variance. An index representing the between-cluster correlation is the *intraclass correlation coefficient* (ρ), a key statistic measuring the proportion of variance attributable to between group differences (Cochran, 1977; Searle *et al.* 1992). Intraclass correlation coefficient was included in this study as an index representing differences between CBs.

To better identify every single contribution of variance explained by costs by adding new variables in the Hierarchical Regression models, an *overall* R^2 *increase table* is presented. Model 1, including gender, age, living situation, occupational status and diagnosis, was compared with Model 2 in which previous psychiatric history was added, and Model 3 that includes all previous variables and SES index.

Results

Data for 4558 patients, with at least one contact with all services of the four mental health catchment areas in the Verona Health District in 2002, were extracted from the PCR. Some patients were excluded: a small number of patients' locations ($n = 67$) were not recognised by the geocoding software; for 56 patients, the addresses were not recorded in the PCR; five patients were excluded from the study because they were homeless (3) or residents in rest homes (1) or in psychiatric residential facilities (1); ten other patients were excluded because the CB they said they lived in was devoid of inhabitants according to the census data (ISTAT, 2001). Thus, the final sample was composed of 4420 patients. Socio-demographic and clinical characteristics of all patients and of each group are presented in Table 1. Regarding the patients' characteristics, 58.30% were female, the mean age was 50.3 years (S.D. = 17.4). The ICD diagnoses were divided into four diagnostic groups: affective disorders (34.25%), schizophrenia (20.48%), neurotic and somatoform disorders (14.21%) and 'other diagnosis' (23.53%), which includes organic psychoses, alcohol dependence, disorders of adult personality and behaviour, etc.

Compared to the other three groups, patients at first contact with services were younger

Table 1. *Socio-demographic characteristics by patient group*

	First-ever $N = 1647$	Ongoing episode $N = 1551$	New episode after 90–1095 days $N = 897$	New episode after 1096 days $N = 325$
Gender				
Male	648 (39.34)	707 (45.58)	345 (39.25)	138 (42.46)
Female	999 (60.66)	844 (54.42)	534 (60.75)	187 (57.54)
Age category (years)				
14–24	156 (9.47)	69 (4.45)	39 (4.35)	9 (2.77)
25–44	572 (34.73)	603 (38.88)	284 (31.66)	97 (29.85)
45–64	485 (29.45)	607 (39.14)	344 (38.35)	136 (41.85)
> 65	434 (26.35)	272 (17.54)	230 (25.64)	83 (25.54)
Marital status				
Single	481 (29.21)	778 (50.16)	327 (36.45)	120 (36.92)
Married	644 (39.10)	518 (33.40)	361 (40.25)	126 (38.77)
Separate, Divorced, Widowed	308 (18.70)	240 (15.47)	162 (18.06)	60 (18.46)
Not known	214 (12.99)	15 (0.97)	47 (5.24)	19 (5.85)
Living situation				
Alone	197 (11.96)	243 (15.67)	124 (13.82)	51 (15.69)
With partner or family	1035 (62.84)	1122 (72.34)	661 (73.69)	236 (72.62)
Others	58 (3.52)	151 (9.74)	47 (5.24)	14 (4.31)
Not known	357 (21.68)	35 (2.26)	65 (7.25)	24 (7.38)
Educational level				
Illiterate	58 (3.52)	67 (4.32)	59 (6.58)	19 (5.85)
Primary or secondary school	825 (50.09)	1044 (67.31)	568 (63.32)	207 (63.69)
Diploma or Degree	356 (21.62)	392 (25.27)	203 (22.63)	73 (22.46)
Not known	408 (24.77)	48 (3.09)	67 (7.47)	26 (8.00)
Occupational status				
Employed	513 (31.15)	399 (25.72)	222 (24.75)	105 (32.31)
Unemployed	126 (7.65)	239 (15.41)	87 (9.70)	39 (12.00)
Retired, student, housewife, voluntary	711 (43.17)	873 (56.29)	521 (58.08)	161 (49.54)
Not known	297 (18.03)	40 (2.58)	67 (7.47)	20 (6.15)
Diagnostic group				
Schizophrenia	121 (7.35)	585 (37.72)	162 (18.06)	37 (11.38)
Affective disorders	557 (33.82)	506 (32.62)	338 (37.68)	113 (34.77)
Neurotic and somatoform disorders	260 (15.79)	165 (10.64)	136 (15.16)	67 (20.62)
Others diagnosis	419 (25.44)	289 (18.63)	230 (25.64)	102 (31.38)
Not known	290 (17.61)	6 (0.39)	31 (3.46)	6 (1.85)
SES index				
SES 1	182 (11.05)	153 (9.86)	98 (10.93)	29 (8.92)
SES 2	434 (26.35)	423 (27.27)	244 (27.20)	91 (28.00)
SES 3	665 (40.38)	569 (36.69)	343 (38.24)	98 (30.15)
SES 4	364 (22.10)	402 (25.92)	212 (23.63)	106 (32.62)
Not known	2 (0.12)	4 (0.26)	0 (0.00)	1 (0.31)
Catchment area				
Catchment area 1	368 (22.34)	398 (25.66)	248 (27.65)	90 (27.69)
Catchment area 2	384 (23.32)	348 (22.44)	210 (23.41)	75 (23.08)
Catchment area 3	476 (28.90)	471 (30.37)	183 (20.40)	144 (44.31)
Catchment area 4	419 (25.44)	334 (21.53)	256 (28.54)	16 (4.92)

($\chi^2 = 119.49$–9 df, $p < 0.0001$), not single ($\chi^2 = 94.41$–6 df, $p < 0.0001$), with a higher educational level ($\chi^2 = 26.93$–6 df, $p < 0.0001$) and employed in a managerial status ($\chi\chi^2 = 75.19$–6 df, $p < 0.0001$). The diagnostic groups of these patients were more likely to be 'affective disorders' and 'other diagnosis' ($\chi^2 = 405.52$–9 df, p-value <0.0001). Patients with an ongoing episode were more likely to belong to the 25–44 age category were single, lived in another situation such as some type of sheltered accommodation,

were unemployed and had a more serious diagnosis, such as schizophrenia.

The patients were distributed across the four SES groups accordingly: SES1-affluent = 10.45%, SES2 = 26.97%, SES3 = 37.90% and SES4-deprived = 24.52%. A similar distribution was also found for each group according to service utilisation, although patients with an ongoing episode or with a new episode after 1096 days were more likely to live in more deprived CBs ($\chi^2 = 25.02$–9 df, $p = 0.003$).

Figure 1 shows the spatial distribution of the census blocks, with their assigned SES value.

For all patients, the mean cost of psychiatric care in 2002 was 2606.11 Euros (S.D. = 7872.96). Patients with an ongoing episode presented a higher mean cost (Kruskal–Wallis test, $p < 0.001$) compared to the other three groups. In detail, the mean cost for patients with an ongoing episode was 4718.1 Euros with a S.D. equal to 10741.4 Euros (median cost = 481.6 Euros), the mean cost for first-ever patients was 1181.1 Euros with S.D. = 4984.7 Euros (median cost = 96.4 Euros), the mean cost for patients with a new episode after 90–1095 days was 1527.2 Euros (S.D. = 5053.9 Euros and median cost = 116.2 Euros) and finally the mean cost for patients with a new episode after 1096 days was equal to 2274.8 Euros (S.D. = 7344.6 Euros and median cost = 109.2 Euros). Patients with psychosis had higher costs in all the four groups than those with other, non-psychosis, diagnoses.

Table 2 shows the results of five multilevel regression models, estimated for each group and for all patients included in the study. Previous psychiatric history (excluding first-ever patients and patients with a new episode after 1096 days, as this information was not registered), represented the most significant predictor of costs, although diagnosis was also significant in each model. A diagnosis of schizophrenia compared with other diagnoses ($p < 0.05$) and a higher previous utilisation ($p < 0.05$) increased the costs. The covariates in previous history that explained the highest costs in service utilisation, were: *Sheltered accommodation contacts in previous year* and *Admissions in previous year*.

In the models for patients with an ongoing episode or a new episode after 90–1095 days, a one-year increase in age decreased the costs of care by about 35 Euros ($p < 0.01$). In the hierarchical multiple regression model for patients with an ongoing episode, patients with a new episode after 90–1095 days and also for all patients, the *intraclass correlation coefficient* is low (respectively 7.8, 2.3 and 15.2% variance is attributable to CBs differences), while in the remaining models, ρ is higher. This means that the previous psychiatry history, when this information was available, explains the fraction of variance differentiating the CBs in costs, whereas when this information is not included, the adjusted R^2 is lower and the variance is attributable to between-group differences increases. Nevertheless, it is important to note that a ρ greater than 0.01 for all models justifies the choice of hierarchical method.

Table 3 presents the overall R^2 increase by adding new variables in the Hierarchical Regression models: only socio-demographic variables and diagnosis explain 4.96% of variance in costs for all patients; by adding the previous psychiatric history a 36.99% increase was estimated, while socio-economic conditions contributed towards less than 1% of the R^2 increase.

For patients with psychosis, the mean cost of care was 5388.87 Euros (S.D. = 11244.86) and for the non-psychosis group the mean cost was only 1716.34 Euros (S.D. = 6276.90). So patients with psychosis presented a higher mean cost (t test, $p < 0.001$) compared to the other patient group.

Table 4 compares two Hierarchical Regression models on costs, respectively, for all patients with a psychotic diagnosis and non-psychotic patients. In the first diagnostic group, all variables concerning previous psychiatric history were significant ($p < 0.01$) in explaining an increase in costs, while in the non-psychotic diagnostic group only *Admission days in previous year*, *Admission in previous year*, *Day contacts in previous year* and *Outpatient contacts in previous year* explained highest costs in service use. Patients with a psychotic diagnosis showed very high cost increases in *Admission in previous year* and in *Sheltered accommodation contacts in previous year* compared with not-psychotic patients. In the model for psychotic patients, age and gender also seem to explain costs variance: for each year increase in patients' age the hierarchical multiple regression model predicted a significant 90.62 Euro decrease in costs ($p < 0.0001$), while costs in services use for *females* resulted in 1361.62 Euros more than for *males*. Looking at the R^2, the model explains 50% of variance in costs for psychotic patients, while only 28% is explained for non-psychotic patients.

Discussion

This study examined the role of individual socio-demographic characteristics, previous psychiatric history and socio-economic conditions of the patients' place of residence in predicting costs of psychiatric care. The use of multilevel analyses enables data analysis simultaneously at the levels of the individual and ecological unit. As this was a case register study, it was possible to consider all patients who had a contact with a psychiatrist, psychologist or another

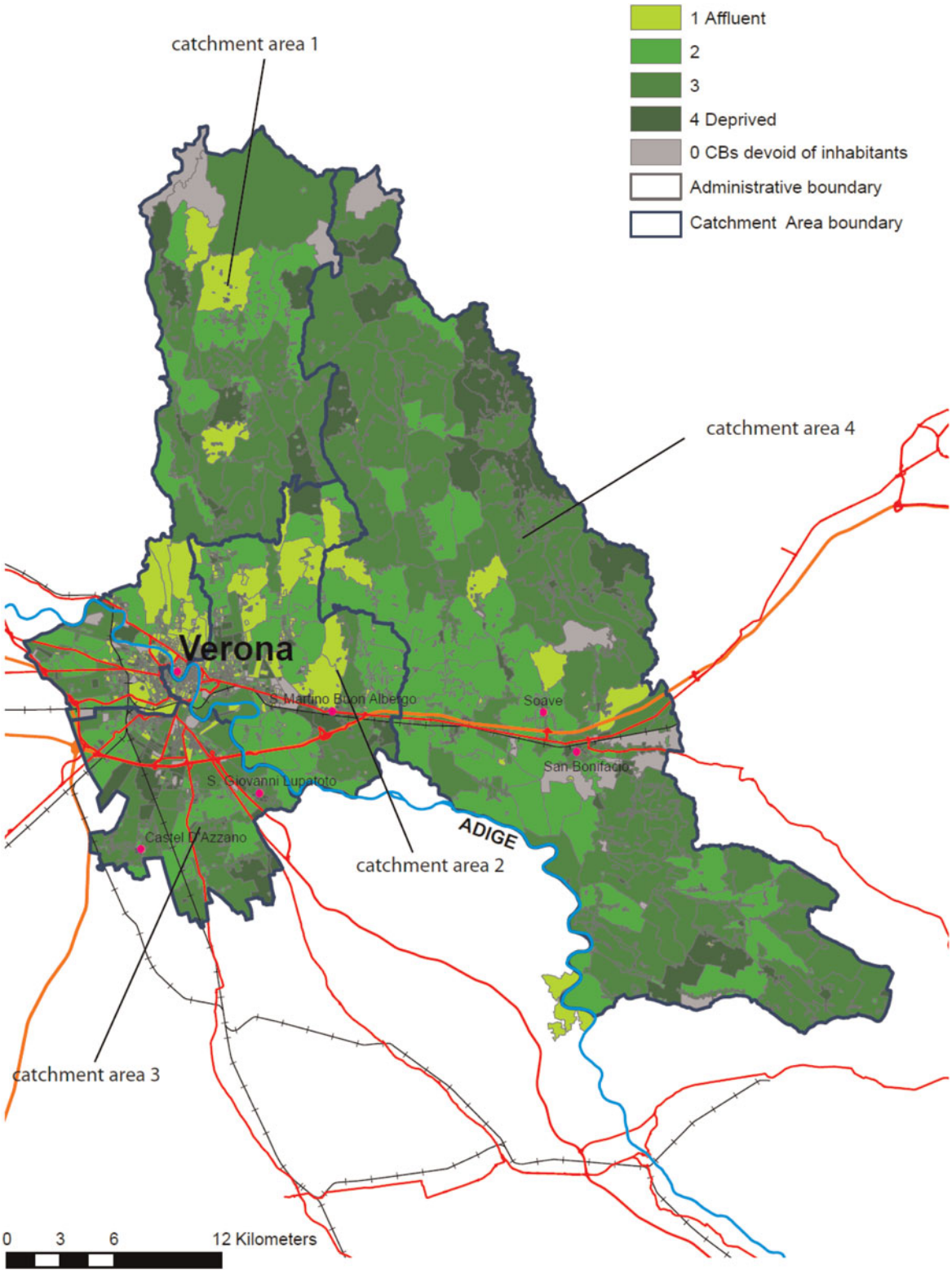

Fig. 1. SES distribution in Verona (A colour version of this figure is available online at http://journals.cambridge.org/eps)

professional working in the psychiatric services of the Verona Health District in 2002. The patients were divided into four groups on the basis of their previous service utilisation. This classification was chosen on the basis of the previous studies conducted in the same catchment area (Tansella *et al.* 1995; Mirandola *et al.* 2004) to consider the different frequency and type of contacts and continuity of care among patients

Table 2. *Hierarchical regression models on costs by patients group*

	First-ever		Ongoing episode		New episode after 90–1095 days		New episode after 1096 days		All patients	
	Coefficient	*p*-value	Coefficient	*p*-value	Coefficient	*p*-value	Coefficient	*p*-value	Coefficient	*p*-value
Previous psychiatric history										
Days spent in hospital in previous year	–	–	75.59	**<0.0001**	51.38	**0.012**	–	–	72.08	**<0.0001**
Admissions in previous year	–	–	1139.73	**<0.0001**	2308.25	**<0.0001**	–	–	1169.89	**<0.0001**
Day contacts in previous year	–	–	83.66	**<0.0001**	69.15	**0.002**	–	–	82.78	**<0.0001**
Outpatient contacts in previous year	–	–	51.10	**<0.0001**	71.71	0.192	–	–	38.61	**<0.0001**
Community care contacts in previous year	–	–	152.34	**<0.0001**	8.56	0.966	–	–	139.17	**<0.0001**
Sheltered accommodation contacts in previous year	–	–	4874.49	**<0.0001**	–	–	–	–	4925.18	**<0.0001**
Age										
Age	−13.94	0.191	−39.53	**0.008**	−33.96	**0.007**	−34.97	0.279	−25.44	**0.001**
Gender										
Female *v*. Male	−607.45	0.096	503.28	0.19	−69.95	0.850	311.35	0.758	119.18	0.596
Living situation										
With partner or family *v*. Alone	223.28	0.655	−485.68	0.372	−671.92	0.178	700.19	0.573	−201.93	0.513
Others *v*. Alone	155.95	0.869	81.98	0.924	−1300.18	0.146	637.27	0.816	−24.19	0.964
Occupational status										
Unemployed *v*. employed	1419.48	**0.023**	640.08	0.240	546.16	0.393	−432.51	0.781	828.88	**0.019**
(Retired, student, housewife, voluntary) *v*. employed	599.28	0.191	543.50	0.279	391.30	0.398	473.84	0.683	367.27	0.191
Diagnostic group										
Affective disorders *v*. schizophrenia	−2240.48	**<0.0001**	−351.64	0.458	−1247.28	**0.012**	−3679.99	**0.023**	−860.76	**0.003**
(Neurotic and somatoform disorders) *v*. schizophrenia	−2954.61	**<0.0001**	−645.13	0.336	−1183.56	**0.043**	−5514.00	**0.002**	−1212.48	**0.001**
Others diagnosis *v*. schizophrenia	−2967.89	**<0.0001**	−1138.78	**0.035**	−1324.40	**0.011**	−5443.15	**0.001**	−1292.65	**<0.0001**
SES index										
SES = 2 *v*. SES = 1	637.30	0.415	380.34	0.604	241.08	0.702	−2215.32	0.209	206.45	0.638
SES = 3 *v*. SES = 1	430.68	0.563	−586.78	0.412	−808.39	0.183	−1929.87	0.271	−526.62	0.215
SES = 4 *v*. SES = 1	933.36	0.250	717.86	0.345	−410.93	0.528	−1990.29	0.251	317.41	0.494
Adjusted R^2	**0.068**		**0.564**		**0.118**		**0.055**		**0.429**	
ρ^*	**0.264**		**0.078**		**0.023**		**0.521**		**0.152**	

**Intraclass correlation coefficient*:proportion of variance attributable to between-group differences.

Table 3. *R^2 increase in adding new variables in the Hierarchical Regression models*

Model	R^2	R^2 increase
Model 1: gender, age, living situation, occupational status, diagnosis	0.0501	–
Model 2: Model 1 + previous psychiatric history	0.4191	+0.3690
Model 3: Model 2 + SES index	0.4205	+0.0014

who were first ever or with an ongoing episode or reopening a new or an old episode of care. Higher costs resulted for patients with an ongoing episode, which one can relate to the profile of these patients, who were likely to have a more severe diagnosis, to be single, a resident in a psychiatric residential facility or sheltered accommodation and unemployed. These seem to be the most chronic patients, for whom, as described in Tansella *et al.* (2006), resources are targeted by our community-based services to provide integrated interventions such as medication, family support and social care. Accordingly, the costs of their care are higher.

As reported in other studies (Jones *et al.* 2007), previous psychiatric history is one of the most consistent predictive variables of psychiatric costs and this is confirmed by this study. Regarding all patients and the four groups of patients, diagnosis was confirmed as a significant variable in predicting costs but, although diagnosis was significant in each model, it explains only a minimum percentage of the total cost variation.

The proportions of the cost variation explained by the model that considered individual and local characteristics are very high, particularly for patients with a diagnosis of psychosis. This is probably because this group is more homogeneous than the other non-

Table 4. *Hierarchical regression models on costs by patients divided in psychotic and non-psychotic diagnostic groups*

	Psychosis				Not psychosis			
	Coefficient	95% confidence intervals		*p*-value	Coefficient	95% confidence intervals		*p*-value
Previous psychiatric history								
Admission days in previous year	70.86	50.34	91.37	**<0.0001**	82.67	53.07	112.27	**<0.0001**
Admission in previous year	1284.79	664.10	1905.47	**<0.0001**	790.58	145.22	1435.94	**0.016**
Day contacts in previous year	88.06	80.35	95.78	**<0.0001**	74.75	68.77	80.72	**<0.0001**
Outpatient contacts in previous year	32.64	11.42	53.85	**0.003**	42.15	16.89	67.42	**0.001**
Community care contacts in previous year	152.33	86.77	217.88	**<0.0001**	−18.48	−107.56	70.59	0.684
Sheltered accommodation contacts in previous year	5138.34	2992.52	7284.15	**<0.0001**	452.92	−6593.11	7498.94	0.900
Age	−90.62	−129.79	−51.44	<0.0001	−11.27	−24.78	2.25	0.102
Gender								
Female *v.* male	1361.62	387.22	2336.01	**0.006**	−353.96	−774.87	66.95	0.099
Living situation								
With partner or family *v.* alone	−455.66	−1799.23	887.90	0.506	−266.80	−841.62	308.01	0.363
Others *v.* alone	75.14	−1799.78	1950.05	0.937	−292.67	−1408.09	822.74	0.607
Occupational status								
Unemployed *v.* employed	813.65	−788.12	2415.42	0.319	619.21	−81.62	1320.04	0.083
(Retired, student, housewife, voluntary) *v.* employed	1359.06	19.58	2698.55	**0.047**	135.87	−374.86	646.60	0.602
SES index								
SES = 2 *v.* SES = 1	−608.17	−2474.67	1258.33	0.523	524.45	−318.91	1367.81	0.223
SES = 3 *v.* SES = 1	−1500.83	−3297.02	295.36	0.101	32.32	−778.07	842.71	0.938
SES = 4 *v.* SES = 1	−806.84	−2671.61	1057.94	0.396	889.42	−2.51	1781.35	0.051
Adjusted R^2	**0.500**				**0.277**			
ρ*	**0.000**				**0.184**			

**Intraclass correlation coefficient*:proportion of variance attributable to between-group differences.

psychotic group, which includes patients with a variety of different diagnoses, and also because of the greater use of mental health-care resources made by psychotic patients, particularly inpatient care. This finding is in keeping with studies conducted elsewhere, for example, in Spain where Baca-Garcia *et al.* (2008) found costs for individuals with psychoses and more specifically, schizophrenia, to be higher than for other patient groups. Indeed it has been previously highlighted in the international literature that the costs of care for patients with schizophrenia and other psychoses are particularly high, as demonstrated by studies conducted in Australia (Carr *et al.* 2003) and England (Mangalore & Knapp, 2007).

However, comparing costs of mental health care across different countries requires some caution, as different studies use different methods and data sources to calculate costs and include different variables. For example, the costs for our study were based on a unit cost list developed locally in Italy (Amaddeo *et al.* 1995) and calculated in Euros, whereas the study by Baca-Garcia *et al.* (2008) calculated costs in international dollars using tables provided by the World Health Organisation for the Global Burden of Disease EUR-A region (WHO, 2000). Regarding the range of variables, our study included costs of care that ranged from inpatient, out-patient, day patient and visits to patients in their homes, whereas the study by Baca-Garcia *et al.* (2008) just included inpatient, emergency care and ambulatory visits. Furthermore, these two studies only included direct costs, whereas other studies have also included indirect costs such societal and government costs, including welfare benefits and lost productivity/time loss associated costs for patients and families (Carr *et al.* 2003; Mangalore & Knapp, 2007). As commented by Knapp *et al.* (2002), when reporting on the EPSILON study that examined costs of care for schizophrenia in five European countries, methodological consistency is required when comparing costs across different countries and settings.

Regarding patients' SES, for all patients and each group of patients, no significant association between SES of the area where patients lived and costs of patients' care emerged. These results seem to indicate that psychiatric costs are uniform in the Verona catchment area throughout all residential areas, irrespective of SES characteristics. Interestingly, SES also did not contribute towards a higher R^2 increase. Therefore, the SES index seems to be more of a control variable, rather than a main predictor.

In contrast to the findings of Tello *et al.* (2005*a*, *b*), those patients who had a previous psychiatric history and were living in more deprived CBs in 2002 did not have higher costs of care. Moreover, in the present study, the SES index is not related to costs, not even for the group of patients with a diagnosis of psychosis as found in the study by Tansella *et al.* (1993). Nevertheless, cost is considered as a comprehensive variable that includes not only the frequency of contacts but also the nature of each contact in terms of staff and structure involvement.

This study used data collected via a PCR and integrated geographic information with registry data. As described by Amaddeo & Tansella (2009) the use of information technology facilitates the linkage of electronic health and non-health data and represents an important opportunity for epidemiological research. Although the use of the PCR has distinct advantages, with the Verona PCR having a long tradition of accuracy, it is acknowledged that case register studies present the possibility of limitations of data quality and comprehensiveness of the dataset.

Another relevant study limitation is that people living in the Verona Health District may seek care from psychiatrists and clinical psychologists in private practice, as well as from GPs, all these consultations are not reported to PCR and this may have influenced our results. The non-psychotic group is more likely to be treated by private specialists or GPs as these patients can be more often treated in private outpatient facilities only and the major focus of public services is on severe disorders like psychosis diagnostic group. For this reason, the number of non-psychotic patients here considered is only partial and the costs of non-psychotic patients may be underestimated. However, moving from a Public Health perspective, this study is not directly interested in services founded with out-of-pocket payments. In general, further studies are necessary to understand how the organisation of mental health services and the private–public financial system could influence the utilisation and the costs of services.

It is also important to be aware of the temporal gap between the census data collection (2001) and service use data collection (2002). However, it is considered that between this relatively brief time period the economic characteristics of the study area have remained relatively constant.

Methodologically, this study has expanded the application of the SES index to the larger catchment area of the Verona Health District and has also based its values on the whole Italian territory by using national census data. The majority of previous studies in Italy have used regional or municipal SES indices to compare ecological factors and different outcome of health (Caranci *et al.* 2009). In the future, the Verona SES Index could be used to evaluate different Italian contexts with very different socio-economic conditions and patterns of care.

Finally, this study has taken further the previous work conducted on this topic by considering the local characteristics of the localities where patients live, as possible predictors of psychiatric costs of care. For the policy-makers, who have to take decisions on the distribution of resources in different local health districts, particularly for mental health services, it is crucial to base their decision processes on the analysis of data that also consider the socio-economic characteristics of the area where the patients live. Although this is well known, it is still unclear which methodological approach should be used. This study has produced a greater understanding of the methodology that can be used to disentangle the several effects of variables that may influence utilisation and costs of psychiatric services.

Another relevant finding of our analyses is the fact that first-ever patients (in their first treatment year) cost four times less than those with an ongoing episode. Moreover, having had more contacts in the previous year increases the subsequent costs in the following years. These findings suggest that early intervention programs, for example, for psychosis, could drive more effective care and reduce the chronicity. Policy-makers who focus on these targets could downsize the costs for mental health care.

Declaration of interest

None

References

Amaddeo F, Tansella M (2009). Information systems for mental health. *Epidemiologia e Psichiatria Sociale* **18**, 1–4.

Amaddeo F, Bonizzato P, Rossi F, Beecham J, Knapp M, Tansella M (1995). La valutazione dei costi delle malattie mentali in Italia: sviluppo di una metodologie e possibili applicazioni (Evaluating costs of mental illness in Italy: the development of a methodology and possible applications). *Epidemiologia e Psichiatria Sociale* **4**, 145–162.

Amaddeo F, Beecham J, Bonizzato P, Fenyo A, Knapp M, Tansella M (1997). The use of a case register to evaluate the costs of psychiatric care. *Acta Psychiatrica Scandinavica* **95**, 189–198.

Baca-Garcia E, Perez-Rodrigues M.M., Basurte-Villamor I, Quintero-Gutierrez FJ, Sevilla-Vicente J, Martinez-Vigo M, Artes-Rodriguez A, Fernandez del Moral AL, Jimenez-Arriero MA, Gonzalez de Rivera JL (2008). Patterns of mental health service utilization in a general hospital and outpatient mental health facilities: analysis of 365,262 psychiatric consultations. *European Archives of Psychiatry and Clinical Neuroscience* **258**, 117–123.

Beecham J, Hallam A, Knapp M, Baines B, Fenyo A, Ashbury M (1997). Costing care in the hospital and the community. In *Care in the community; illusion or reality?* (ed. J. Leff), pp. 93–108. John Wiley and Sons: Chichester.

Caranci N, Costa G (2009). Un indice di deprivazione a livello aggregato da utilizzare su scala nazionale: giustificazioni e composizione. *Salute & Società* **8**, 58–78.

Carr VJ, Neil AL, Halpin SA, Holmes S, Lewin TJ (2003). Costs of schizophrenia and other psychoses in urban Australia: findings from the Low Prevalence (Psychotic) Disorders Study. *Australian and New Zealand Journal of Psychiatry* **37**, 31–40.

Cochran WG (1977). *Sampling Techniques*. Wiley: Toronto.

Curtis S, Copeland A, Fagg J, Congdon P, Almog M, Fitzpatrick J (2006). The ecological relationship between deprivation, social isolation and rates of hospital admission for acute psychiatric care; a comparison of London and New York City. *Health and Place* **12**, 19–37.

Drukker M, Gunther N, VanOs J (2007). Disentangling associations between poverty at various levels of aggregation and mental health. *Epidemiologia e Psichiatria Sociale* **16**, 3–9.

Egon (2009). Retrieved 18 June 2009 from http://www.wareplace.it/.

Ginsberg G, Lerner Y, Mark M, Popper M (1997). Prior hospitalization and age as predictors of mental health resource utilization in Israel. *Social Science and Medicine* **44**, 623–633.

Grigoletti L, Amaddeo F, Grassi A, Boldrini M, Chiappelli M, Percudani M, Catapano F, Fiorillo A, Perris F, Bacigalupi M, Albanese P, Simonetti S, De Agostini P, Tansella M, I-PSYCOST Group (2010). A predictive model to allocate frequent service users of community-based Mental Health Services to different packages of care. *Epidemiologia e Psichiatria Sociale* **19**, 168–177.

ISTAT (2001). *XIV Censimento della Popolazione e delle Abitazioni*. Istituto Poligrafico e Zecca dello Stato: Roma.

Jones J, Amaddeo F, Barbui C, Tansella M (2007). Predicting costs of mental health care: a critical literature review. *Psychological Medicine* **37**, 467–77.

Knapp M, Chisholm D, Leese M, Amaddeo F, Tansella M, Schene A, Thornicroft G, Vazquez-Barquero JL, Knudsen HC, Becker T, EPSILON. European Psychiatric Services: Inputs Linked to Outcome Domains and Needs (2002). Comparing patterns and costs of schizophrenia care in five European countries: the EPSILON study. *Acta Psychiatrica Scandinavica* **105**, 42–54.

Mangalore R, Knapp M (2007). Cost of schizophrenia in England. *Journal of Mental Health Policy and Economics* **10**, 23–41.

McCrone P, Thornicroft G, Parkman S, Nathaniel-James D, Ojurongbe W (1998). Predictors of mental health service costs for representative cases of psychosis in south London. *Psychological Medicine* **28**, 159–164.

McDaid D, Knapp M, Curran C, The MHEEN Group (2006). Meeting the challenge of funding and allocating resources to mental health across Europe: developing the Mental Health Economics European Network. *Epidemiologia e Psichiatria Sociale* **15**, 117–122.

Mirandola M, Amaddeo F, Dunn G, Tansella M (2004). The effect of previous psychiatric history on the cost of care: a comparison of various regression models. *Acta Psychiatrica Scandinavica* **109**, 132–139.

Searle SR, Casella G, McCulloch CE (1992). *Variance Components*. Wiley: New York.

Stata Corporation (2005). *Stata Statistical Software: Release 9*. Stata Corporation LP: College Station, TX.

Tansella M, Bisoffi G, Thornicroft G (1993). Are social deprivation and psychiatric service utilisation associated in neurotic disorders? A case register study in south Verona. *Social Psychiatry and Psychiatric Epidemiology* **28**, 225–230.

Tansella M, Micciolo R, Biggeri A, Bisoffi G, Balestrieri M (1995). Episodes of care in first-ever psychiatric patients. A long term case-register evaluation in a mainly urban area. *British Journal of Psychiatry* **167**, 220–227.

Tansella M, Amaddeo F, Burti L, Lasalvia A, Ruggeri M (2006). Evaluating a community-based mental health service focusing on evere mental illness. The Verona experience. *Acta Psychiatrica Scandinavica* **113** (Suppl. 429), 90–94.

Tello JE, Mazzi M, Tansella M, Bonizzato P, Jones J, Amaddeo F (2005*a*). Does socioeconomic status affect the use of community-based psychiatric services? A South Verona case register study. *Acta Psychiatrica Scandinavica* **112**, 215–223.

Tello JE, Jones J, Bonizzato P, Mazzi M, Amaddeo F, Tansella M (2005*b*). A census-based socio-economic status (SES) index as a tool to examine the relationship between mental health services use and deprivation. *Social Science and Medicine* **61**, 2096–2105.

Thornicroft G, Bisoffi G, De Salvia D, Tansella M (1993). Urban rural differences in the association between social deprivation and psychiatric service utilization in schizophrenia and all diagnoses: a case-register study in Northern Italy. *Psychological Medicine* **23**, 487–496.

Tiainen A, Edman G, Flyckt L, Tomson G, Rehnberg C (2008). Regional variations and determinants of direct psychiatric costs in Sweden. *Scandinavian Journal of Public Health* **36**, 483–492.

World Health Organisation (WHO) (1992). *The ICD-10 Classification of Mental and Behavioural Disorders: Clinical Description and Diagnostic Guidelines*. WHO: Geneva.

World Health Organisation (WHO) (2000) World Health Organisation CHOosing Interventions that are Cost Effective (WHO-CHOICE). Retrieved 25 April 2011 from http://www.who.int/choice/costs/en/.

Zulian G, Donisi V, Secco G, Pertile R, Tansella M, Amaddeo F (2011 in press). How are caseload and service utilisation of psychiatric services influenced by distance? A geographical approach to the study of community-based mental health services. *Social Psychiatry and Psychiatric Epidemiology* [26 June 2010;Epub ahead of print]