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Introduction: Neighbourhood composition is considered a social determinant of mental health that can be addressed by policymakers to improve outcomes. Deprived neighbourhoods typically lack resources such as leisure and park facilities but also daycare centres. However, the study of specific needs and resource distribution tailored to the clinical-demographic features of mental health service users is still in its infancy.

Aim: In this study, we aimed to identify discrepancies between neighbourhood resources and epidemiological composition of a representative sample of mental health service users in the large metropolitan area of Milan in Italy.

Methods: In a cross-sectional study design, we described neighbourhood-specific density of community services and the socio-demographic and clinical features of residents who accessed local mental health services in the same geographical areas. Data were retrieved from municipal and mental health registries and analysed at a neighbourhood level and at a higher level of neighbourhood clustering based on territory coverage of three mental health departments.

Results: At the neighbourhood level, no significant difference could be observed between resources of the three identified urban areas. However, a strong heterogeneity of resource localization was observed for public housing properties, social services, juvenile community homes, social aggregation spaces and day centres for disabled individuals after controlling for population density across the three areas. This heterogeneity did not match the distribution of service users or specific diagnosis-related needs across different urban districts. Non-affective psychoses were found to be more frequently diagnosed in deprived neighbourhoods, whereas anxiety disorders were most frequent in an area which incorporates relatively more affluent neighbourhoods. Further studies including a neighbourhood-level socio-economic index are needed to confirm the likelihood of these associations.

Conclusion: Our preliminary findings suggest a heterogeneous distribution of diagnoses across city areas, which might reflect uneven neighbourhood resources. Overall, this study highlights the need to adequately tailor neighbourhood resources to the specific mental health needs of vulnerable individuals.

101	Keywords separated by ' - '	Neighbourhood resources - Mental health administration - Socio-economic condition - Severe mental disorders - Social deprivation
102	Foot note information	Edoardo G. Ostinelli and Armando D'Agostino contributed equally to this work.

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Mental health services and the city: a neighbourhood-level epidemiological study

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Abstract

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Keywords Neighbourhood resources · Mental health administration · Socio-economic condition · Severe mental disorders · Social deprivation

Edoardo G. Ostinelli and Armando D'Agostino contributed equally to this work.

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36 **Introduction**

37 Psychiatric disorders have received increasing attention
 38 worldwide from policymakers, largely due to their impact on
 39 socio-economic and overall health status of patients (Patel
 40 et al. 2007). The notion that mental health is a multilevel
 41 phenomenon, influenced by multiple social contexts, and
 42 influencing itself multiple contexts, has existed for centuries.
 43 During the nineteenth century, physicians and social reformers
 44 across Europe documented that some ways of living and
 45 working conditions were related to high rates of disease, par-
 46 ticularly among the poor (Engels 1958; Villerme 1988;
 47 Virchow 1988). According to the Organisation for Economic
 48 Co-operation and Development (OECD), one in two people
 49 will develop a mental illness at some point in their lives, with
 50 adverse effects on their productivity, wages and employment
 51 opportunities (Hewlett and Moran 2014).

52 Mental health is usually determined by a complex interac-
 53 tion of socio-cultural, psychological, environmental, urban
 54 and demographic factors (Jackson et al. 2010). The prevalence
 55 of psychiatric disorders is significantly associated with age,
 56 marital status, educational level, employment and health-
 57 related quality of life (HRQoL) (Alegria et al. 2002).
 58 Psychiatric disorders, such as depression and anxiety, are also
 59 influenced by educational level, income and occupation
 60 (Barry 2009; Lenze et al. 2001; Meyer et al. 2014).

61 At an individual level, the demographic and socio-economic
 62 correlates of psychiatric disorders have been widely demonstrat-
 63 ed (Burvill 1995; Lorant et al. 2003). However, socio-economic
 64 conditions that influence mental health can also be studied at an
 65 ecological level (Amaddeo et al. 2015). Contextual and urban
 66 effects are defined as measures that are associated with individ-
 67 ual health (Diez Roux 2003; Duncan et al. 1995; Macintyre et al.
 68 1993). The social environment includes groups to which indi-
 69 viduals belong, the neighbourhoods in which they live, the or-
 70 ganization of workplaces and the policies created to regulate
 71 everyday life. Although the influence of the social environment
 72 has been demonstrated for a range of physical health outcomes
 73 (McKenzie et al. 2002; Pickett and Pearl 2001; Yen and Syme
 74 1999), their association with outcomes in mental health has been
 75 studied more rarely and with mixed results (Pickett and Pearl
 76 2001). The lack of homogeneity in study designs and measures
 77 of mental health and neighbourhoods has strongly limited the
 78 possibility of generalizing findings on their relationship (Truong
 79 and Ma 2006). Nonetheless, neighbourhood composition is con-
 80 sidered among the social determinants that can be addressed to
 81 improve mental health outcomes in the framework of the United
 82 Nations Sustainable Development Goals (Lund et al. 2018).

83 Subjects with mental disorders are among the vulnerable in-
 84 dividuals who are most significantly influenced by
 85 neighbourhood characteristics because of general limitations in
 86 mobility and so-called “activity space” (Gale et al. 2011; Vallée
 87 et al. 2011). Very few studies have examined demographic and

socio-economic variables and urban context across psychiatric 88
 disorders in representative samples from large European metro- 89
 politan areas. Although available data are sparse, neighbourhood 90
 deprivation has been associated with an increase in mental health 91
 service users, sustaining the need to direct resources towards 92
 more deprived communities (Bhavsar and McGuire 2018). 93
 Poorer neighbourhoods are usually characterized by a lack of 94
 several resources, ranging from leisure and park facilities to 95
 daycare centres (Leventhal and Brooks-Gunn 2000). 96
 Significantly fewer mental health problems have been reported 97
 for male adolescents who were experimentally moved with their 98
 families to relatively less poor neighbourhoods in New York 99
 City (Leventhal and Brooks-Gunn 2003). However, the study 100
 of different distribution patterns of resources in the territory in 101
 relationship to specific clinical-demographic features of service 102
 users is still in its infancy. 103

104 From this perspective, Italian mental health services offer
 the advantage of a strict overlap with the urban territory. Since
 1978, mental health care has been based on a community-
 based model of care that is organized according to local health
 districts which serve a well-defined geographic area. Each
 district is served by a Department of Mental Health (DMH),
 which supplies a range of in- and outpatient services. Since the
 first Regional Mental Health Plan, the Lombardy region
 adopted an organizational model centred on multi-
 disciplinary teams. These teams include psychiatrists, psy-
 chologists, nurses, social workers, occupational therapists, re-
 habilitation counsellors and auxiliary staff. According to the
 Plan and subsequent revisions, DMHs should provide a full
 range of psychiatric care, from acute emergency treatment to
 long-term rehabilitation (Lora et al. 2012). The organization
 of related economic costs implies that individuals who seek
 public mental health interventions can only receive them from
 the DMH covering the district in which they reside. In this
 context, an association between service use and catchment
 area resources has been reported in small suburban territories
 (Donisi et al. 2013). 124

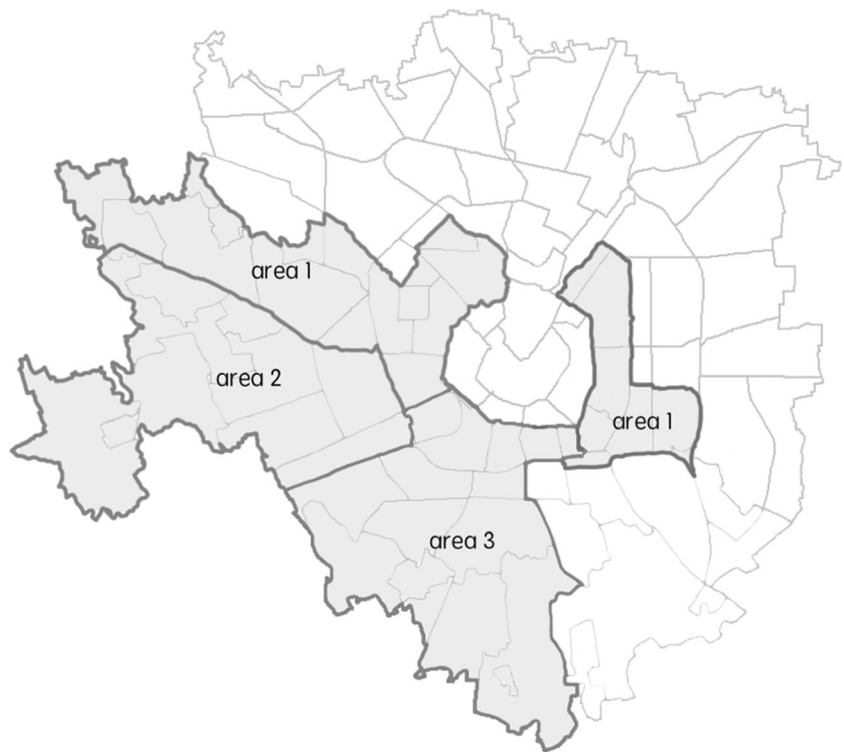
125 The aim of this study was to identify discrepancies between
 the neighbourhood resources and epidemiological composi-
 tion of a representative sample of mental health service users
 from the large metropolitan area of Milan in Italy. 128

129 **Methods**

130 **Socio-environmental data**

131 The Municipality of Milan is divided into 88 local identity
 nuclei (Fig. 1). These nuclei are defined as neighbourhoods
 characterized by differing historical and projectual identities.
 132
 133 Data on the social environment of the nuclei can be publicly
 accessed from the Italian National Institute of Statistics
 (ISTAT), the leading Italian producer of official statistics in
 134
 135
 136

Fig. 1 Urban districts covered by three Departments of Mental Health in Milan, Italy (area 1, Fatebenefratelli Hospital; area 2, San Carlo Hospital; area 3, San Paolo Hospital). Toponomastic data retrieved from http://dati.comune.milano.it/dataset/ds61_infogeo_nil_localizzazione on November 1, 2019



137 the service of citizens and policy-makers ([http://dati-](http://dati-censimentopopolazione.istat.it/Index.aspx)
 138 [censimentopopolazione.istat.it/Index.aspx](http://dati-censimentopopolazione.istat.it/Index.aspx)). The most recent
 139 population and housing census began in 2011 and the most
 140 complete data published on the municipality of Milan date
 141 back to 2012. All available data on the characteristics of the
 142 urban context on December 31, 2012, were obtained from the
 143 Statistics section of the municipality. The same data have
 144 become partially available through open platforms that can
 145 be accessed online (<http://sisi.comune.milano.it/>).

Clinical population

147 The Regional register for mental health services PsicheWeb was
 148 employed to collect data from all subjects who accessed three
 149 Departments of Mental Health in Milan, Italy. All interventions,
 150 ranging from interviews with social workers to medical visits to
 151 rehabilitation are recorded on the register since 1999. Data are
 152 entered by one administrative professional in each Department.
 153 Demographic information, ICD-10 diagnoses and all interven-
 154 tions in any setting are recorded (Lora et al. 2012).

155 The three Departments involved organize the activity of the
 156 district mental health services associated with Fatebenefratelli,
 157 San Carlo and San Paolo Hospitals. For the purpose of this study,
 158 they were renamed as follows: Area 1 (Fatebenefratelli), Area 2
 159 (San Carlo) and Area 3 (San Paolo). These are large, public
 160 metropolitan multi-service hospitals covering 10 of the 20 public
 161 health districts of the city, grouped into a total of 6 areas. These
 162 20 districts overlap with 88 local identity nuclei of the
 163 Municipality of Milan (Fig. 1). All users who had any form of

contact with these Departments from January 1 to December 31, 164
 2012, were screened for inclusion. Data from a total of 9456 165
 subjects were retrieved. The identification code available on 166
 the system was converted into a new anonymous code to pre- 167
 serve the patients' privacy. According to the variable of interest, 168
 cases were excluded on the basis of missing data; 1754 (18.5%) 169
 subjects were excluded because their district of residence did not 170
 overlap with the Area of the mental health department they 171
 contacted. 172

Study design

This retrospective, cross-sectional, register-based study was 174
 designed according to the following two levels: 175

Environmental level

The urban context related to the neighbourhoods in which the 177
 patients reside was accurately characterized through a large set 178
 of variables, subdivided into groups: population demo- 179
 graphics (density, gender, families, foreigners, migrants, elder- 180
 ly, newborn, dead); schooling services; welfare services (out- 181
 patient mental health services, juvenile community homes, 182
 non-profit and voluntary associations, social aggregation 183
 spaces for all residents and those for youth and for the elderly, 184
 social guardians, socio-recreational spaces for the elderly, 185
 occupational therapy laboratories, day centres for disabled indi- 186
 viduals, family consulting rooms, public housing properties, 187
 public transportation, bike trails, parishes); law enforcement; 188

189 recreational facilities (sport facilities, libraries, bars, restau-
 190 rants and shops). The neighbourhoods were regrouped ac-
 191 cording to the public health districts from which the mental
 192 health data had been derived. According to the nature of the
 193 variable, rates were either calculated in relationship to km² or
 194 expressed as a number for 10,000 inhabitants of the territory.

195 **Epidemiological level**

196 A set of variables were chosen to describe the clinical popu-
 197 lation that accessed the mental health services of interest. All
 198 data were subdivided according to the DMH of afference. The
 199 following patient variables were considered: gender, age of
 200 first contact with service, nationality, civil status, education
 201 and occupation. The number of patients with at least one con-
 202 tact during the year with any DMH service was considered the
 203 prevalence of service use. Crude rates were calculated as the
 204 number for 10,000 adult inhabitants of the inherent territory.
 205 Inhabitants with age < 18 years were excluded from this cal-
 206 culation because clinical data were derived from adult ser-
 207 vices. We calculated the prevalence of individuals with a com-
 208 mon mental disorder and the population density per local
 209 identity nuclei in the South-west area of Milan.

210 **Statistical analyses**

211 Descriptive statistics were employed to report information on
 212 epidemiological features of the study population and on
 213 neighbourhood composition. Continuous variables were re-
 214 ported as means and standard deviation, whereas categorical
 215 variables were reported as percentages. Shapiro-Wilk tests
 216 revealed non-normal distributions of environmental and pop-
 217 ulation data. Therefore, Kruskal-Wallis and chi-square tests
 218 were performed to explore differences between groups, with
 219 Bonferroni-corrected Dunn's pairwise comparison as post hoc
 220 analysis. A highly conservative ± 3 cut-off was used for ad-
 221 justed standardized residuals to identify the largest deviations
 222 from expected values in associated variables.

223 A Pearson product moment correlation coefficient was
 224 computed to assess the relationship between the density of
 225 population at a neighbourhood level and the prevalence of
 226 residents with a diagnosis of any mental disorders. The
 227 STATA 16 statistical software was employed to conduct all
 228 analyses (StataCorp. 2019).

229 **Results**

230 **Socio-environmental characteristics of the urban**
 231 **context**

232 Table 1 shows the distribution of all urban variables of interest
 233 across the three mental health areas, in combination (termed

South-west Milan) and over the whole city. The South-west 234
 Milan territory covers 46.1% of the whole city, where 50.6% 235
 of the city population lives. All available population demo- 236
 graphics (range 44.9%–54.5%) and schooling (range 46.9– 237
 48.9%) services were generally representative of the whole city. 238

When median neighbourhood-level resources were com- 239
 pared among the three areas, no significant difference could be 240
 observed. However, inspection of data controlled for population 241
 density at the area level of clustering revealed that Areas 1 and 2 242
 were generally consistent with the whole city, whereas Area 3 243
 had a higher number of families (6425/10,000 inhabitants vs. 244
 4862/10,000 of the whole city), foreigners (2182/10,000 vs. 245
 1871/10,000), migrants (538/10,000 vs. 411/10,000), newborns 246
 (111/10,000 vs. 91/10,000) and deaths (141/10,000 vs. 106/ 247
 10,000). Welfare services were also generally representative, 248
 with the relevant exception of public housing services, 67.1% 249
 of which are located in the South-west Milan territory. Sixteen of 250
 10,000 public housing properties were found to be located in 251
 this area compared with an average 12/10,000 inhabitants over 252
 the whole city. This increase was found to be clearly driven by 253
 Areas 2 (19/10,000) and 3 (21/10,000). Public transportation 254
 services were representative of those available over the whole 255
 urban territory in terms of surface stops but not underground 256
 stops, which were found to be lower in South-west Milan 257
 (0.41/km² vs. 0.51/km²). In terms of surface stops, Areas 1 258
 and 2 had remarkably variable heterogeneity with 29.5/km² 259
 and 15.4/km² respectively, compared with the 20.4/km² of the 260
 whole city. Territorial support for ecological transportation was 261
 also found to be underdeveloped in Area 2, where only 9.3% of 262
 the city bike trails could be found. Law enforcement services 263
 were representative (42.7%), whereas recreational facilities were 264
 found to be lower than the city average in South-west Milan for 265
 museums, expositive spaces (30.2%) and cinemas (41.5%). In 266
 particular, Area 2 has no museum or expositive space compared 267
 with the 6/100,000 inhabitants found throughout the whole city. 268

Epidemiology of mental health service users 269

Table 2 shows the available clinical and demographic data of 270
 service users. When all areas were considered together (South- 271
 west Milan), mean age of first contact was found to be 39.7 ± 272
 15.8, with a male-to-female ratio of approximately 44%–56%. 273
 Almost exactly half of service users were unmarried and the 274
 vast majority declared a secondary education (8 years, 40.4%; 275
 13 years, 32.5%). Over a third (36.6%) of users resided within 276
 their own family, whereas most of the others lived in their 277
 family of origin (30.6%) or alone (25.5%). Approximately 278
 one quarter of users declared no employment at the time of 279
 contact, whereas 41.2% declared some form of employment. 280

With the exception of gender distribution, all other vari- 281
 ables differed significantly across the three urban areas inves- 282
 tigated. Education level was significantly associated with ur- 283
 ban areas [$\chi^2(12) = 278,0210, p < 0,0001$]. The strongest 284

Table 1 District population demographics and facilities in the territory of three mental health departments and in the whole Municipality of Milan

	Area 1	Area 2	Area 3	South-west Milan	Milan
t1.1	Population demographics				
t1.2					
t1.3	338,185 (25.20%)	158,787 (11.83%)	182,059 (13.57%)	679,031 (50.60%)	1,341,830 (100%)
t1.4	35.41 (19.48%)	22.87 (12.58%)	25.54 (14.05%)	83.82 (46.11%)	181.77 (100%)
t1.5	9550.65	6942.71	7128.34	8100.98	7381.93
t1.6	46.58-53.42%	46.84-53.16%	47.58-52.42%	46.91-53.09%	47.61-52.39%
t1.7	157,644 (24.16%)	75,012 (11.50%)	116,969 (17.93%)	349,625 (53.59%)	652,455 (100%)
t1.8	4661.47	4724.06	6424.79	5148.88	4862.43
t1.9	48,782 (19.43%)	24,177 (9.63%)	39,718 (15.82%)	112,677 (44.87%)	251,091 (100%)
t1.10	1441.47	1522.61	2181.60	1659.38	1871.26
t1.11	12,026 (21.81%)	5337 (9.68%)	9802 (17.77%)	27,165 (49.26%)	55,146 (100%)
t1.12	355.60	336.11	538.40	400.06	410.98
t1.13	12,136 (25.43%)	5846 (12.25%)	7913 (16.58%)	25,895 (54.27%)	47,718 (100%)
t1.14	358.86	368.17	434.64	381.35	355.62
t1.15	2831 (23.33%)	1267 (10.44%)	2025 (16.68%)	6123 (50.45%)	12,137 (100%)
t1.16	83.71	79	111.23	90.17	90.45
t1.17	3360 (23.65%)	1822 (12.82%)	2566 (18.06%)	7748 (54.52%)	14,210 (100%)
t1.18	99.35	114.75	140.94	114.10	105.9
t1.19	Schooling services				
t1.20	131 (18.74%)	98 (14.02%)	113 (16.17%)	342 (48.93%)	699 (100%)
	3.874	6.172	6.207	5.037	5.209
	28 (19.58%)	18 (12.59%)	21 (14.69%)	67 (46.85%)	143 (100%)
	0.828	1.134	1.153	0.987	1.066
	20 (22.22%)	12 (13.33%)	11 (12.22%)	43 (47.78%)	90 (100%)
	0.591	0.756	0.604	0.633	0.671
	21 (24.14%)	5 (5.75%)	15 (18.39%)	41 (47.13%)	87 (100%)
	0.621	0.315	0.824	0.604	0.648
t1.21	Welfare services				
t1.22	4 (21.05%)	2 (10.53%)	2 (10.53%)	38 (42.11%)	19 (100%)
t1.23	0.118	0.126	0.110	0.118	0.142
t1.24	17 (26.56%)	7 (10.94%)	5 (7.81%)	29 (45.31%)	64 (100%)
t1.25	0.503	0.441	0.275	0.427	0.477
t1.26	206 (23.52%)	64 (7.31%)	109 (12.44%)	379 (43.26%)	876 (100%)
t1.27	6.091	4.031	5.987	5.581	6.528
t1.28	4 (6.56%)	14 (22.95%)	9 (14.75%)	27 (44.26%)	61 (100%)
t1.29	0.118	0.882	0.494	0.398	0.455
t1.30	9 (18.37%)	6 (12.24%)	6 (12.24%)	21 (42.86%)	49 (100%)
	0.266	0.378	0.330	0.309	3.65

t2.1 **Table 2** Service user demographics across three mental health departments in South-west Milan^p

t2.2	Area 1	Area 2	Area 3	p value*
t2.3	Age (years)			
t2.4	40.63 ± 15.7	40.04 ± 16.4	38.3 ± 15.0 ↑	< 0.001
t2.5	At first contact (mean ± SD)			
	n = 2577	n = 2272	n = 2172	< 0.001
	≤ 17 years old	4.2%	3.9%	
	18–64 years old	88.5%	90.1% ↑	
	65–79 years old	7.2%	5.5% ↓	
	≥ 80 years old	1.2%	0.5% ↓	
t2.6	51.38 ± 15.2	52.45 ± 16.1 ↓	48.97 ± 14.9 ↑	< 0.001
t2.7	Age (mean ± SD)			
	n = 2752	n = 2278	n = 2154	< 0.001
	≤ 17 years old	0.4% ↑	0.1%	
	18–64 years old	80.0%	83.9% ↑	
	65–79 years old	16.8%	20.1% ↑	
	≥ 80 years old	3.2%	3.6%	
t2.8	Gender			
	n = 2819	n = 2348	n = 2198	n.s.
	Male – female (n %)	44.1–55.9%	45.0–55.0%	42.9–57.1%
t2.9	Marital status			
	n = 2738	n = 2335	n = 2169	< 0.05
	Unmarried	50.8%	49.2%	52.2%
	Married	31.5%	30.8%	30.6%
	Separated	5.8%	7.5%	6.6%
	Divorced	7.0%	6.6%	6.8%
	Widowed	4.9%	6.0%	3.8%
t2.10	Education			
	n = 2635	n = 2322	n = 2154	< 0.001
t2.11	0.7% ↓	0.9% ↑	1.2%	
t2.12	10.3% ↓	19.5% ↑	13.1%	
t2.13	34.9% ↓	43.9% ↑	43.4% ↑	
t2.14	37.6% ↑	28.3% ↓	31.0%	
t2.15	16.5% ↑	7.4% ↓	11.3%	
t2.16	Residential status			
	n = 2707	n = 2336	n = 2159	< 0.001
	Alone	28.3% ↑	24.7%	22.8% ↓
	Family of origin	27.7% ↓	33.0% ↑	31.5%
	Own family	36.1%	37.7%	36.0%
	Other relatives	5.5%	2.6% ↓	6.8%
	Community home	1.1%	1.2%	2.0%
	Retirement home	0.1%	0.3%	0%
	Other non-psychiatric institution	0.1%	0.1%	0.1%
	Prison	0.1%	0.2%	0.2%
	Homeless	0.1%	0%	0%
	Other	0.9%	0.3%	0.4%
t2.17	Occupational status			
	n = 2687	n = 2333	n = 2162	< 0.001
	Unemployed	28.3% ↑	22.7% ↓	26.2%
	Students	4.6%	4.0%	4.5%
	Retired	15.7%	16.7% ↑	11.5% ↓
	Invalid	7.7% ↓	20.7% ↑	14.0%
	Other	2.7% ↑	0.8% ↓	2.3%
	Employed – worker	14.3%	13.5%	13.6%
	Employed – manager	16.6%	13.9% ↓	19.2% ↑
	Self-employed	5.1% ↑	2.8%	2.7%
	Military	0.0%	0.2%	0.0%
	Home duties	4.9%	4.8%	6.1%
t2.18	Economic sector			
	n = 2343	n = 1891	n = 1617	< 0.001
	Primary sector	1.1%	0.1% ↓	1.1%
	Secondary sector	6.1%	7.5%	5.3%
	Business	9.4% ↑	4.8% ↓	9.1%
	Public administration services	17.2% ↑	7.7% ↓	11.4%
	Other, non-professional	66.1% ↓	80.1% ↑	73.2%
t2.19	Diagnosis			
	n = 2819	n = 2348	n = 2198	< 0.001
	Neurocognitive disorders	3.4% ↑	2.7%	1.5%
	Substance-related and addictive disorders	1.6%	1.3%	2.4%
	Schizophrenia spectrum disorders	24.4%	31.1% ↑	22.1% ↓
	Mood disorders	25.7%	24.6%	25.7%

t2.20 **Table 2** (continued)

	Area 1	Area 2	Area 3	<i>p</i> value*
Anxiety disorders	29.0% ↑	21.7% ↓	28.3%	
Feeding and eating disorders	0.5% ↓	1.1%	4.1% ↑	
Personality disorders	12.1%	11.8%	9.7%	
Intellectual disability	1.2% ↓	3.0%	3.2% ↑	
Neurodevelopmental disorders	0.8%	1.2%	1.0%	
Not specified	1.3%	1.5%	2.0%	

*Kruskal-Wallis rank test was used for continuous variables; chi-square test was used for categorical variables. Arrows show significant deviations from expected values with the largest adjusted standardized residuals (± 3)

285 differences were observed between Areas 1 and 2, across
 286 which service users with education ≥ 13 years were reciprocally
 287 distributed. Occupational status was also associated with
 288 urban areas, with a higher-than-expected proportion of unem-
 289 ployed individuals in Area 1 and the opposite in Area 2
 290 [$\chi^2(18) = 274,1001, p < 0,0001$]. The most significant dis-
 291 crepancy could perhaps be observed in terms of invalidity
 292 status, which ranged from 7.7% in Area 1 to 20.7% in Area
 293 2. The crude prevalence rate of service users across the inves-
 294 tigated territories was 96/10,000 adult population for Area 1,
 295 168/10,000 for Area 2 and 100/10,000 for Area 3. Taken
 296 together, the general rate for South-west Milan was 113/
 297 10,000. Age-adjusted prevalence rates confirm the distribu-
 298 tion across all available ranges, including < 18 years. The
 299 largely predominant age grouping of service users at the time
 300 of data collection was 18–64 years across areas. Three major
 301 diagnostic clusters with an overlapping distribution were identi-
 302 fied (schizophrenia spectrum, 25.8%; mood disorders,
 303 25.3%; anxiety disorders, 26.5%). Diagnostic clusters were
 304 also found to differ significantly across areas. Schizophrenia
 305 spectrum disorders were more frequently diagnosed in Area 2
 306 and less frequently in Area 3, whereas anxiety disorders were
 307 more frequently diagnosed in Area 1 and less in Area 2
 308 [$\chi^2(18) = 234,0884, p < 0.0001$].

309 Table 3 shows the subdivision of the same variables
 310 according to patients' diagnostic clusters. Compared with
 311 all other diagnostic subgroups, patients with an eating dis-
 312 order were more likely to access adult services before
 313 18 years of age. A third (34.9%) of patients who had a first
 314 contact with adult services < 18 years of age were diag-
 315 nosed with a schizophrenia spectrum disorder; 11.4% of
 316 patients with mood disorders and 10.5% of those with anxi-
 317 ety disorders accessed services for the first time at $>$
 318 65 years of age. Indeed, these two diagnostic clusters cover
 319 71.1% of all those patients in this age range who had a first
 320 contact with a mental health service. The relative distribu-
 321 tion of diagnoses for each age group at first contact and at
 322 the time of data collection is shown in Fig. 2. Figure 3
 323 shows the direction of the difference between median
 324 values for age of first contact (a) and age at the time of
 325 data collection (b), respectively.

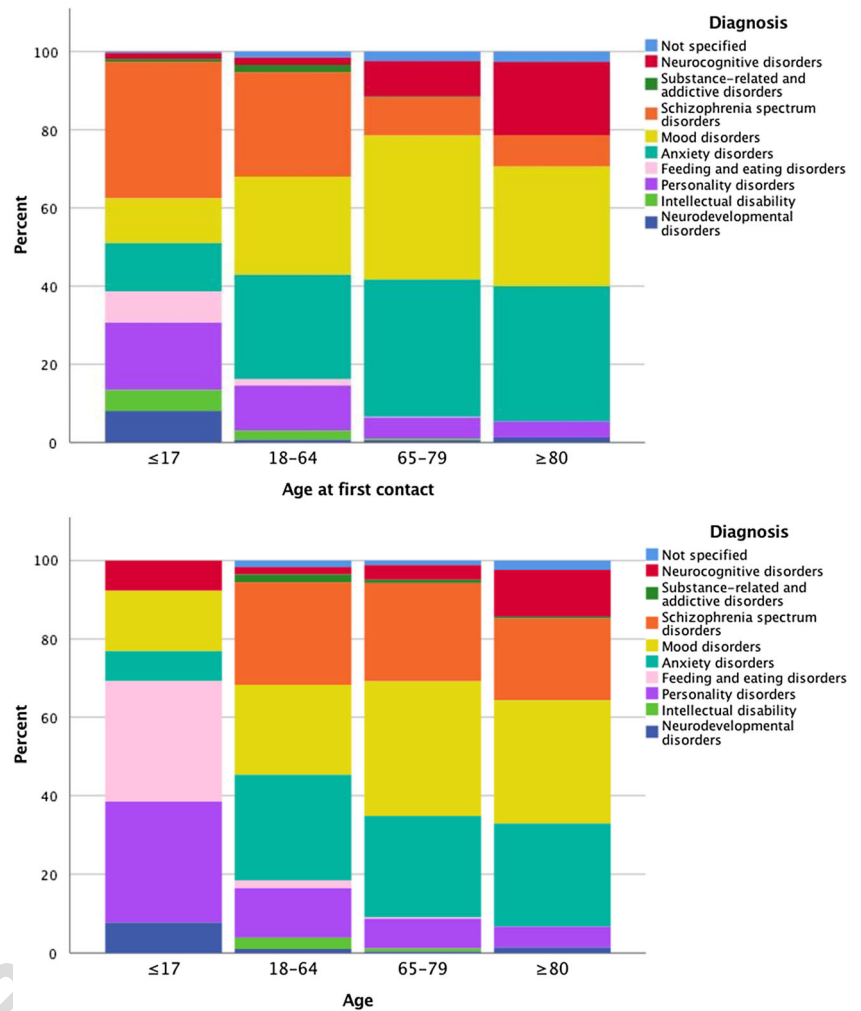
Finally, we investigated the relationship between the den-
 sity of population at a neighbourhood level and the prevalence
 of residents with a diagnosis of any mental disorders, purpose-
 ly excluding four local identity nuclei to prevent introducing a
 bias in our estimates given their special characteristics (i.e.
 regional parks not serving as residential areas). None of our
 analyses showed a statistically significant correlation, consid-
 ering either the common mental disorders jointly together or
 as specific subgroups Fig. 4.

Discussion

This large epidemiological study yielded two main results: (1)
 the number of several territory resources differed substantially
 across three large urban areas, although the difference subsided
 when median values were considered at a neighbourhood
 level; (2) the distribution of mental health service users diag-
 nosed with schizophrenia and anxiety disorders appears to
 differ substantially across urban territories, the former being
 associated with the most deprived area and the latter with the
 most affluent one. Because available South-west Milan popu-
 lation demographics were in line with those from the whole
 city, it seems possible to generalize findings to the metropol-
 itan territory.

In the urban context of Milan, our data confirm the gener-
 ally low use of mental health services observed in Italy com-
 pared with other European countries (Alonso et al., 2004). In
 general, the prevalence of service use in South-west Milan
 was slightly lower than available regional estimates (Lora
 et al. 2012). Schizophrenia spectrum and mood and anxiety
 disorders covered most service users' diagnoses, representing
 over three quarters of the total across the three areas. This is in
 line with available data on public service use in Italy
 (Ferrannini et al. 2014) and—excluding substance use disorder
 patients treated in tailored outpatient units—other
 European countries (Wittchen et al., 2010). The highest rate
 of schizophrenia spectrum diagnoses was observed in Area 2.
 Whereas anxiety disorders were the most frequently diag-
 nosed in Area 1, they were least represented of the three major
 diagnostic spectra in Area 2. In the latter area residents were

Fig. 2 Cumulative percentage of diagnostic clusters grouped by age at first contact with mental health service (top) and age at the time of data collection (bottom)



	Not specified	Neurocognitive Disorders	Substance use disorders	Schizophrenia	Mood disorders	Anxiety disorders	Eating disorders	Personality disorders	Intellectual disability
Neurocognitive Disorders									
Substance use disorders		↓							
Schizophrenia	↓	↓	↓						
Mood disorders		↓		↓					
Anxiety disorders		↓		↓	↑				
Eating disorders	↓	↓	↓		↑	↑			
Personality disorders	↓	↓	↓		↓	↓			
Intellectual disability	↓	↓	↓		↓	↓	↓		
Neurodevelopmental disorders	↓	↓	↓		↓	↓			

Fig. 3 Age of first contact. Arrows indicate the direction of the difference between median values by rows. Dark blue: $p < 0.0001$; blue: $p = 0.001-0.0001$; light blue: $p = 0.05-0.001$

more elderly, invalid, had a lower mean education level and less access to limited neighbourhood resources. This area differs substantially from Areas 1 and 3, which both include more affluent and culturally attractive neighbourhoods of the city centre and have more commercial and recreational facilities but also non-profit and voluntary associations.

Although neighbourhood deprivation has often been associated with higher rates of psychosis in urban populations (O'Donoghue et al. 2016), the nature of this association remains unclear and is perhaps bidirectional. On the one hand, deprived neighbourhoods might increase vulnerability through exacerbation of life stressors and limited access to support. On the other, social drift phenomena might explain higher concentrations of individuals with more severe mental disorders in less affluent neighbourhoods (Lund et al. 2018). Other commentators have observed that the frequently reported association between psychosis and deprived neighbourhoods might imply a causal relationship but also inequality of access opportunity or lack of specific protective factors (Bhavsar 2019). Although progress in this field remains limited, defined geographic areas have recently been

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Fig. 4 Age. Arrows indicate the direction of the difference between median values by rows. Dark green: $p < 0.0001$; green: $p = 0.001-0.0001$; light green: $p = 0.05-0.001$

	Not specified	Neurocognitive Disorders	Substance use disorders	Schizophrenia	Mood disorders	Anxiety disorders	Eating disorders	Personality disorders	Intellectual disability
Neurocognitive Disorders	↑								
Substance use disorders		↓							
Schizophrenia		↓	↑						
Mood disorders	↑		↑	↑					
Anxiety disorders		↓		↓	↓				
Eating disorders	↓	↓	↓	↓	↓	↓			
Personality disorders		↓		↓	↓	↓	↑		
Intellectual disability		↓		↓	↓	↓			
Neurodevelopmental disorders		↓		↓	↓				

385 proposed as targets for refined services and public health in-
 386 terventions in a study which confirmed a relationship between
 387 incident psychosis and socio-economic neighbourhood depri-
 388 vation in another high-income country (Eaton et al. 2019). Of
 389 note, our findings only partially reflect known environmental
 390 risk factors of psychosis such as socio-economic deprivation,
 391 ethnic density or social cohesion. Indeed, the investigated area
 392 with the higher density of foreigners and migrants had a rela-
 393 tively lower proportion of schizophrenia spectrum diagnoses
 394 when compared across areas.

395 This is the first study to clearly report a higher frequen-
 396 cy of diagnosed anxiety disorders in a portion of a large
 397 metropolitan city which incorporates relatively more afflu-
 398 ent neighbourhoods. Indeed, competitive community
 399 norms, achievement pressure and emotional isolation have
 400 been hypothesized to increase the risk of anxiety in youth
 401 who grow up in affluent neighbourhoods (Luthar 2003).
 402 However, the quality of urban neighbourhoods and
 403 neighbourhood deprivation in general have also been asso-
 404 ciated with the presence and severity of anxiety disorders
 405 (Ventimiglia and Seedat 2019). As shown in Fig. 1, Area 1
 406 includes neighbourhoods surrounding the city centre but
 407 also peripheral ones that are likely to account for the
 408 highest unemployment rate observed across areas. Our
 409 findings reflect the distribution of anxiety disorders over
 410 the whole area, so further studies are needed to clarify
 411 the strength of this observation.

Population density was found to be slightly lower and
 somewhat variable across the three areas, ranging from 6761
 (Area 3) to 9551 (Area 1) people/km². This might justify a
 relative increase of most welfare, transportation and commer-
 cial services in the latter. However, a lower consistency was
 observed for some specific services when normalized for pop-
 ulation. Almost a third of all social services found in the city of
 Milan were in Area 1 and juvenile community homes were
 more than double in Area 1 compared with Area 3. On the
 contrary, Area 1 had 4–7 times fewer social aggregation
 spaces and 6–10 times fewer day centres for disabled individ-
 uals compared with the other two areas. This latter finding was
 striking given the similar prevalence of individuals diagnosed
 with intellectual disabilities or neurodevelopmental disorders
 across the two areas. When normalized for population, public
 housing properties were also found to be consistently fewer in
 Area 1. However, the density in this area was equivalent to
 that of the whole city (12/10,000) whereas it was relatively
 higher in both Areas 2 (18/10,000) and 3 (17/10,000). Our
 analyses on population density at a neighbourhood level does
 not support a relationship between urbanization and the prev-
 alence of common mental disorders. The substantial disagree-
 ment on this topic in the published literature highlights the
 need to investigate further and in greater detail the
 influence—if any—exerted by urbanization on mental health
 (Generaal et al. 2019; Judd et al. 2002; Krabbendam and van
 Os 2005; Peen et al. 2010; Zijlema et al. 2015).

439 Limitations

440 The major limitation of our work is the lack of individual-
 441 level information of neighbourhood composition beyond ba-
 442 sic population demographics. Information such as employ-
 443 ment status, income or household wealth is necessary to
 444 develop a reliable socio-economic status (SES) index that
 445 can be used to test specific hypotheses of association with
 446 clinical outcomes in the local population (Tello et al. 2005;
 447 Lasalvia et al. 2014). Reported territory characteristics such
 448 as welfare services or recreational facilities can be included
 449 in an index but cannot directly be correlated with clinical
 450 variables in a meaningful way, so future studies will need to
 451 include a broader set of economic neighbourhood variables
 452 of Milan's local identity nuclei. This will also allow over-
 453 coming another limitation, i.e., that the three large identified
 454 areas overlapping with mental health service user data are
 455 intrinsically not homogeneous. Access to geographically re-
 456 stricted socio-economic variables will lead to higher order
 457 association analyses among comparable neighbourhoods.
 458 Another limitation is the lack of information on patients
 459 treated in private services who reside in the urban context
 460 examined. In particular, mood and anxiety disorders treated
 461 in public mental health services are known to reflect approx-
 462 imately half of all patients with such diagnoses on the whole
 463 territory (Wang et al. 2007).

464 Finally, the method employed to collect patients' clinical
 465 information limited the possibility of retrieving neuropsy-
 466 chiatric or general medical comorbidities. However, the aim
 467 of our study was to analyse the characteristics of the prin-
 468 cipal diagnoses that require mental health service use rather
 469 than individual psychopathological or psychophysical
 470 features.

471 Conclusion

472 The reported data suggest a relationship between non-
 473 affective psychoses and socially deprived neighbourhoods in
 474 a large metropolitan context. Future studies including socio-
 475 economic variables of neighbourhood inhabitants and service
 476 users could be a guide to the development of a socio-
 477 economic index to confirm the likelihood of an association.

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484 Compliance with ethical standards

485 **Conflict of interest** All authors declare that they have no conflicts of
 486 interest.

Ethical approval This article does not contain any studies with animals
 performed by any of the authors. All procedures performed in studies
 involving human participants were in accordance with the ethical stan-
 dards of the institutional and/or national research committee and with the
 1964 Helsinki Declaration and its later amendments or comparable ethical
 standards.

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