Socio-economic disparities in the appropriateness of diabetes care in an Italian region: findings of AEQUITAS study

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ABSTRACT

Background: To evaluate socio-economic disparities in diabetes prevalence and care in Marches (a region of central Italy) in 2003-2010 through a cross-sectional study.
Methods: The databases of 52 general practitioners were mined for people with diabetes (age ≥20 years). These data were linked with records from other regional administrative databases. Healthcare disparities, specifically potentially preventable hospitalizations (PPH) related to diabetes and its complications, were analysed using participants' gender, age, and education data and the Italian Deprivation Index. Crude, age-specific and gender-specific diabetes prevalence was estimated for each year of observation. A time-trend analysis was performed. Admissions that might have been prevented according to Agency for Healthcare Research and Quality criteria were used to calculate the PPH rate for each level of social condition indicators. Rate ratios and 95% confidence intervals were estimated with a multiple Poisson regression model.
Results: The search found 6,494 participants with diabetes mellitus aged ≥20 years. Disease prevalence ranged from 5.4% (2003) to 7.8% (2010), with a significant 0.31% positive trend. Those aged ≤44 years were at significantly higher risk of PPH than older people. A significant PPH excess was found among people living in socio-economically disadvantaged areas. Education and gender did not significantly affect PPH.
Conclusions: People with diabetes seem to use primary care services appropriately irrespective of socio-economic status. Outpatient services are not equally distributed on the regional territory; this may increase disease severity and/or the risk of diabetes complications and affect appropriateness of diabetes care.

Key words: diabetes care appropriateness, preventable hospitalization, socio-economic disparities, healthcare, healthcare databases

INTRODUCTION

Diabetes is a highly common chronic disease almost throughout the world. More than 371 million people worldwide are affected, and its prevalence is on the rise everywhere [1]. According to ISTAT, Italian National Institute of Statistics, approximately 3.2 million people in Italy suffer from diabetes, whose prevalence in 2016 was about 5.3% [2]. During 2008-2011 the total cost for the treatment of patients with diabetes to the Italian National Health Service (INHS) was estimated at about 8.1 billion Euros a year [3] and above 9 billion in 2012 [4], accounting for almost 10% of Italian healthcare expenditure. Similar results were found in a recent study estimating the corresponding cost for diabetes of about 9% of the INHS expenditure in 2012, where 52% of the figure was related to hospitalizations, about 26.4% to medication, and 20% to the outpatient care [5].

Improving care for diabetes people is an important goal, because several complications can be prevented through adherence to clinical practice guidelines [6], continuity of care, and adequate information and education of people with diabetes and families [7]. Indeed, diabetes is an Ambulatory Care Sensitive Condition (ACSC), one where hospitalization can be avoided by preventive care and early management, usually delivered in a primary care setting.

The US Agency for Healthcare Research and Quality (AHRQ) has developed sets of disease and procedure codes to identify conditions involving potentially preventable hospitalizations (PPH) [8] and prevention quality indicators (PQI); these are part of a set of AHRQ quality indicators based on hospital discharge data that allow to identify appropriateness of care for ACSC. Four PQI regard diabetes: uncontrolled disease, short-term complications, long-term complications and lower-extremity amputations [8].

Socio-economic status (SES) is associated with diabetes incidence [9], use of healthcare services [10] and mortality risk [11] in people with diabetes, independently of their country's level of income. There is also evidence that SES is associated with the prevalence of diabetes [12,13] as well as its complications [14,15]. Several studies describe variability in PPH for diabetes, especially in the US. Rates are higher among racial and ethnic minorities than among Caucasians [16-18], and people with low income and/or poor education are more likely to be admitted to hospital for diabetes [19].

In Canada investigations of disparities in PPH for diabetes [20] show an inverse gradient between SES and admission rates. Even though data on the issue are increasing, adequate information from healthcare systems that differ from the one in the US, which is characterized by health insurance and limited public funding [21], is still insufficient. In Italy access to primary healthcare is free and universal at the point of entry and is provided by general practitioners (GP) and paediatricians. Whereas in market-driven healthcare systems, such as the US one, PPH can be used only as a measure of healthcare system performance, reflecting ease of access to primary care, in Italy its evaluation provides a measure of the appropriateness of primary care services [21].

Studies addressing PPH for Ambulatory Care Sensitive Condition (ACSC) in Italy are not numerous [22-26], and most have examined the impact of income level on hospitalization for a pool of ACSC. Agabiti and co-workers analysed PPH for diabetes and for some chronic cardiovascular diseases in four Italian cities [23]. The single nationwide study of PPH for the acute complications of diabetes found a significantly greater rate of discharge for acute diabetic conditions in younger people than in those aged 65 years and older [24], and reported a marked variability among Italian regions.

Project AEQUITAS (Analysis of Equity and Quality of Regional Clinical Pathways in Diabetes Management) was devised to establish whether appropriate healthcare services are provided equally to people with different SES at the level of local health units, and to assess the role of GP in managing a chronic disease such as diabetes. The present study evaluates socio-economic disparity in appropriateness of diabetes care by analysing the rate of PPH for diabetes in relation to inequality indicators and assesses the demand for diabetes care through the calculation of disease prevalence in Marches, a region in central Italy.

METHODS

Study design and data

AEQUITAS is a cross-sectional, multicentre study based on electronic administrative databases. Data for the period from January 1st, 2003 to December 31st, 2010 were obtained from the databases of 52 GP in Marches, who were members of the Italian College of General Practitioners (SIMG) of Marches and used the Millewin information software (vs 13.36.134, 2008) to archive people with diabetes data. In Italy all residents, irrespective of income, employment status and age, are registered with a GP who provides free care. Drugs and examinations are under a co-payment system; people with chronic diseases are not subject to co-payment for the chronic condition, and the poor are totally exempt.

The study sample comprised all people aged ≥ 20 years who were registered with the 52 GP in 2003-2010. The other electronic administrative archives mined to obtain data regarding cases were the regional hospital discharge database, the laboratory analyses database, the prescription drugs database and the disease-specific exemption database. A deterministic linkage procedure was applied using tax codes.

The target population, consisting of all Marches residents in 2003-2010, ranged from 1,240,852 in

2003 to 1,286,289 in 2010, with an increase of about 3.6% over the 8-year period. The participant sample included 55,829 people in 2003 and 65,696 in 2010 (men about 47% throughout), who accounted for about 5% of the target population.

Case ascertainment and completeness of information.

The International Classification of Diseases (ICD) was used to identify people with diabetes and any concomitant conditions. All people with codes ICD9-CM 250.x found in the GP databases and confirmed by each GP as having diabetes were considered as cases and extracted for the analysis. For each case the diagnosis of diabetes and its date were cross-checked in the other archives. The requirement for case ascertainment was a relevant record in at least one of the other administrative databases. GP databases were mined for cases and for socio-demographic data (date of birth, gender, address, education level) and clinical and history information (concomitant conditions, examinations; prescriptions; date and cause of death). The procedure found 6,604 cases. After the exclusion of 110 participants, whose records did not meet the ascertainment requirements, 6,494 were left for the analysis. Level of education data were missing for about 17% of cases (about 30% of people aged 80-94 years).

Indicators of social condition.

Individual and aggregate data were used as indicators of social condition (ISC) to assess disparity in healthcare. The former data included participant gender, age, and education level at the time of the study. Education is a reliable indicator of socioeconomic status [27, 28] because it is relatively stable across the life course after early adulthood, it is comparable across men and woman or single and married; moreover it is not modified by chronic disease, it has been used as primary proxy of socio-economic status in previous studies, thereby allowing comparability with other studies and is less prone to be affected from reverse causality than other socioeconomic status indicators such as income and occupation [29].

The Italian Deprivation Index [30] (IDI), calculated on 2001 Census data, was an aggregate measure, evaluated on a regional basis and applied to each person in relation to the municipality of residence.

Participants were grouped into 4 age classes: ≤44; 45-64; 65-84; and ≥85 years. Education level was dichotomized as less than high school diploma (<=13 years vs >13 years). Municipalities were divided into three categories based on the IDI: 1, rich-very rich; 2, average; and 3, poor-very poor.

The study was approved by the regional ethics committee and complies with the Helsinki Declaration.

DATA ANALYSIS

Diabetes prevalence.

Crude and age- and gender-specific diabetes prevalence and 95% confidence intervals (95%CI) were estimated for each year of observation using the total number of people registered with the 52 GP as the denominator. A time-trend analysis was performed using the Cochrane–Orcutt procedure of generalized least squares regression analysis for estimating the regression parameters with control of 1st-order autocorrelation [31]. Crude and age-standardized prevalence, with the 2003 people with diabetes distribution as the reference population to control for distribution changes over time, were used as the dependent variables in the time-trend analysis.

Indicators of appropriateness of disease management.

The discharges of all cases identified in the GP databases were extracted from the regional discharge archives. Only the records involving any of the four diabetes-related conditions that define PPH according to the PQI [8] were considered. Their ICD9-CM codes are: 250.02 or 250.03, uncontrolled diabetes (high glucose concentrations); 250.1–250.3, short-term complications (ketoacidosis, hyperosmolarity, or coma); 250.4–250.9, long-term complications (renal, eye, neurological, circulatory, or complications not otherwise specified); and 84.1, lower-extremity amputations.

The PPH rate among adults with diabetes and 95%CI were calculated within each ISC level, age-standardized on the world standard population, using the direct method (5-year age classes) and expressed as number of admissions per 100 diabetic person-years.

A multiple Poisson regression model was used to estimate rate ratios (RR) and 95%CI, using the most affluent ISC category as the reference. The number of PPH occurring during the study period was the dependent variable, and gender, age class, level of education, and IDI were the explanatory variables. Interactions between variables were also tested; person-years were included in the model as the offset. Because of the large quota of missing data for education level, a third category including these missing values was included in the analysis.

The statistical package R was used for all analyses. A level of probability of 5% was set to assess statistical significance.

RESULTS

There were 6,494 individuals with diabetes mellitus aged ≥ 20 years in 2003-2010 according to the GP databases. Overall diabetes prevalence ranged from 5.4% (95%CI 5.3-5.6) in 2003 to 7.8% (95%CI 7.6-8.0) in 2010, with a significant 0.31% positive trend (95%CI 0.23%-0.38%).

The prevalence data by gender are reported in Table 1 for each year of observation. From 2003 to 2010 crude prevalence increased by about 49% and 39% in men and women, respectively. Every year prevalence was significantly higher in men than in women and showed a significant positive trend in both (men: b=0.37%; 95%CI 0.26%-0.47%; women: b=0.25%; 95%CI 0.19%-0.31%). Age-standardized diabetes prevalence also increased over this time significantly. As expected, the prevalence estimates were lower than the crude estimates, but there was a significant positive trend for both genders (men: b=0.29%; 95%CI 0.20%-0.38%; women: b=0.16%; 95%CI 0.09%-0.23%).

The prevalence of diabetes in three representative years in relation to age and gender is reported in Table 2. Prevalence increased with age in both genders and the highest values were found among people > 64 years old, i.e. the two older age classes (65-84 and > 85). Significant gender differences were found for the first three age classes (20-44; 45-64; 65-84), men showing consistently the highest prevalence except for the 20-44 age class in 2010.

A total of 524 potentially preventable hospitalizations (PPH) were detected, accounting for 4.35 preventable admissions per 100 person-years (95%CI 4.22-4.48). PPH rates by gender, age class, level of education, and municipality of residence according to the Italian Deprivation Index are listed in Table 3.

Rate ratios, estimated using multiple Poisson regression analysis (Table 4), show that gender and level of education did not significantly affect PPH rates, whereas significantly lower rates were found in people aged 45-64, 65-84, and ≥ 85 years than in 20-44 year olds. People living in average and poor-very poor municipalities experienced significantly higher PPH rates than those living in rich-very rich municipalities. No 2nd or 3rd order interaction term between variables was significant.

DISCUSSION

This study was based on data found in administrative archives, with General Practitioner (GP) databases as the main source for case identification. Crude diabetes prevalence was 5.4% at the beginning of the study (2003) and 7.8% at the end (2010). The crude prevalence data reported by Gini [32] and co-workers based on GP databases (6.7%; 95%CI 6.4-7.1) is similar to ours (7.5%; 95%CI 7.3-7.7 in 2009); the slight difference may be due to the fact that their study involved a single small town

TABLE 1. Prevalence of diabetes in Marches from 2003 to 2010

	2003	2004	2005	2006	2007	2008	2009	2010
Men								
Prevalent cases (n)	1,538	1,652	1,945	2,146	2,307	2,483	2,628	2,699
Crude prevalence	5.86	6.29	7.23	7.43	7.76	8.35	8.50	8.73
95%CI	5.57 - 6.15	6 - 6.59	6.92 - 7.54	7.13 - 7.74	7.46 - 8.07	8.04 - 8.67	8.19 - 8.82	8.42 - 9.05
Standardized prevalence*	5.86	6.29	7.23	7.07	7.37	7.94	7.78	7.97
95%CI	5.57 - 6.15	6 - 6.59	6.92 - 7.55	6.76 - 7.39	7.06 - 7.7	7.61 - 8.27	7.46 - 8.11	7.64 - 8.3
Women								
Prevalent cases (n)	1,495	1,587	1,830	1,975	2,109	2,253	2,352	2,440
Crude prevalence	5.06	5.37	6.04	6.08	6.30	6.73	6.76	7.02
95%CI	4.81 - 5.31	5.11 - 5.63	5.77 - 6.31	5.82 - 6.34	6.04 - 6.57	6.47 - 7.01	6.5 - 7.03	6.75 - 7.29
Standardized prevalence*	5.06	5.37	6.04	5.85	6.05	6.45	6.29	6.48
95%CI	4.81 - 5.31	5.11 - 5.63	5.77 - 6.32	5.58 - 6.12	5.78 - 6.32	6.17 - 6.74	6.02 - 6.58	6.21 - 6.77

**Age-standardized using the 2003 individuals distribution as the reference population*

TABLE 2. Diabetes prevalence estimates and 95% Confidence Intervals according to age and gender in Marches in three representative years

	2003	2006	2010
Age classes	**Prevalence (95%CI) [%]**	**Prevalence (95%CI) [%]**	**Prevalence (95%CI) [%]**
Women			
20 - 44	0.4 (0.3 - 0.6)	0.6 (0.5 - 0.7)	0.7 (0.6 - 0.9)
45 - 64	4 (3.6 - 4.4)	4.5 (4.1 - 5)	4.9 (4.5 - 5.3)
65 - 84	13.1 (12.3 - 13.9)	15 (14.2 - 15.8)	16.5 (15.7 - 17.3)
≥ 85	12.6 (10.8 - 14.7)	14.6 (12.9 - 16.4)	18.6 (17.0 - 20.3)
Men			
20 - 44	0.7 (0.6 - 0.9)	0.8 (0.7 - 1)	1 (0.8 - 1.2)
45 - 64	6.9 (6.3 - 7.4)	8.4 (7.8 - 8.9)	8.7 (8.1 - 9.2)
65 - 84	14.8 (13.9 - 15.8)	17.8 (16.9 - 18.8)	21.5 (20.6 - 22.5)
≥ 85	13.4 (10.7 - 16.6)	16.5 (13.9 - 19.4)	16.3 (14.1 - 18.7)

of Marches and also included people aged ≤ 20 years. The prevalence estimates obtained from GP databases are usually higher than those calculated based on other administrative archives, because GP databases include people with mild diabetes that can be controlled by the diet, who are not prescribed diabetes medications, are not admitted to hospital and do not ask for exemption from healthcare payment [32,33].

Age-standardized prevalence increased by about 36% in men and 28% in women from 2003 to 2010, similar to other studies in Italy [34]. Our findings also agree with the WHO Global Burden of Disease Study, which reports that adults with diabetes are increasing worldwide both in developed and developing countries [35]. The increase is due above all to population ageing and urbanization; these factors will more than double the number of people with diabetes in the near future. Since the proportion of the population older than 65 years will increase globally, and since in developed countries the prevalence of diabetes is highest among those older than 64 years [35,36], the social burden of diabetes and its complications is set to rise dramatically. Besides, our data show a significant increase in age-standardized prevalence, which indicates the amount of cases arising independently of ageing and/or increase of the population.

Over the 8-year period considered, there were 524 preventable admissions with age-standardized rates of 4.65% and 4.06% for men and women, respectively. Moreover, people aged ≤ 44 years were at significantly higher risk of preventable hospitalization than those aged > 44. This pattern is inconsistent with most of the literature, which shows that preventable admissions are most likely to occur at the beginning and the end of life [37], but is supported by a study conducted in the US, where Wang et al [7] calculated admission rates using the four AHRQ diabetes-related PPH conditions applied in our study and people with diabetes as the denominator. They found an age-adjusted rate of overall diabetes-related PPH of 3.8% in 2006, with a significantly higher rate for individuals aged 18-44 years than for those aged 45-74 years. The PPH rate was highest in the youngest people with diabetes also in an Italian nationwide study [24] focusing on the acute complications of diabetes. Those aged 20–44 years had double admission rates for preventable acute complications than those aged 65 years and older even after accounting for the significant decline in admissions observed from 2001 to 2010 for all age groups.

Indeed, according to ISTAT hospital admissions with diabetes as the main diagnosis fell from 2000 to 2015 [2], particularly in people aged > 65 years. These data can help explain the low admission rates found in our study for people aged ≥ 45 years, and suggest an overall improvement in the quality of diabetes outpatient care in Italy. In fact, Italian healthcare policies have increasingly been focusing on diabetes since 1987, when law provisions defined it as one with "high social interest". This attitude is also reflected in the successive INHS Prevention Plans since 2003. Marches was one of the first regions to apply national directives, and a 2009 Regional law established the realization of an integrated healthcare system for the prevention and care of diabetes and its complications based on a network of specialists, GP, and local health units.

According to our data socio-economic factors also play a significant role in preventable admissions. People living in poor-very poor and average municipalities were respectively 60% and 44% more likely to experience a preventable admission for diabetes than those living in the richer municipalities. Even though in Italy residents enjoy free universal access to healthcare, an excess of preventable admissions was still found for individuals living in socially and economically disadvantaged areas.

TABLE 3. Age-standardized rates (per 100 people with diabetes, on World Standard Population) and 95% Confidence Intervals for preventable admissions according to gender, education, and the Municipalities according to the Italian Deprivation Index in 2003-2010.

	AGE CLASSES		
Age Classes	**Preventable admissions (n)**	**Person-years**	**Rate (95%CI) [%]**
Women	236	14,852	4.06 (3.88 - 4.23)
20-44	22	557	5.53 (5.19 - 5.89)
45-64	67	3,483	2.43 (2.22 - 2.67)
65-84	122	9,073	1.29 (1.03 - 1.60)
≥ 85	25	1,739	2.34 (0.94 - 4.82)
Men	288	16,038	4.65 (4.46 - 4.83)
20-44	42	788	6.93 (6.51 - 7.37)
45-64	103	5,866	1.7 (1.52 - 1.90)
65-84	125	8,614	1.52 (1.24 - 1.86)
≥ 85	18	770	2.34 (1.21 - 4.09)
Education			
Women			
≥ High school	27	1,418	4.2 (3.99 - 4.41)
<High school	178	11,112	3.57 (3.31 - 3.82)
Missing	31	2,324	3.94 (3.70 - 4.20)
Men			
≥ High school	58	3,295	4.72 (4.45 – 5.00)
<High school	192	10,415	4.2 (4.01 - 4.4)
Missing	38	2,328	3.76 (3.54 – 4.01)
Municipalities according to the Italian Deprivation Index			
Women			
Rich very rich	65	5,232	3.28 (2.97 - 3.59)
Average	29	1,403	4.67 (4.29 - 5.05)
Poor –very poor	139	8,145	5.26 (4.86 - 5.65)
Men			
Very Rich-Rich	107	6,161	5.58 (5.30 - 5.86)
Medium	45	1,769	9.24 (8.09 - 10.39)
Poor –very poor	135	8,007	2.33 (2.20 - 2.47)

TABLE 4. Preventable admissions according to the inequality indicators. Rate Ratios and 95% Confidence Intervals. Results of multiple regression analysis

Variables	**Category**	**RR* (95%CI)**	**p**
Gender	Men vs Women	1.36 (1.00 - 1.86)	0.052
Age classes	45-64 vs 20-44 ys	0.37 (0.28 - 0.49)	<0.001
	65-84 vs 20-44 ys	0.28 (0.22 - 0.38)	<0.001
	≥ 85 vs 20-44 ys	0.35 (0.23 - 0.52)	<0.001
Education	< High school vs ≥ High school	1.18 (0.93 - 1.52)	0.191
	Missing vs ≥ High school	0.98 (0.70 - 1.36)	0.705
MIDI	Average vs Rich-very rich	1.6 (1.02 - 2.46)	0.035
	Poor-very poor vs Rich-very rich	1.44 (1.07 - 1.95)	0.016

**RR = Rate Ratios*
MIDI = Municipalities according to the Italian Deprivation Index

It should be considered that patients resident in different areas of Marche Region, characterized by different level of deprivation, may refer to different hospitals, potentially having different rules of coding procedure. This aspect should be further investigated to quantify its effect on the association between PPH rates and MIDI. However, neither gender nor education significantly affected PPH rates. These data seem to indicate that primary care services are appropriately used by people with diabetes independently of their SES, but that outpatient services are not equally distributed and/or accessible on the regional territory. This inequality may increase the risk and/or severity of diabetes complications and adversely affect the appropriateness of diabetes care. The adoption of specific regional programmes has the potential to address these disparities in Marches. Additional studies into the role played by the territorial distribution of diabetes care services in relation to socio-economic condition are however required to gain further insights into diabetes treatment and management in Italy.

Competing Interests

None declared

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