CLINICAL

Gender Differences in Healthcare Utilization of Patients With Diabetes

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Objectives: To examine gender differences in healthcare utilization including outpatient and inpatient medical care for patients with type 2 diabetes mellitus (T2DM) despite participation in T2DM-specific disease management programs (DMP-DM).

Study Design: Baseline data from a cohort study in southwest Germany including 1146 patients with T2DM recruited between October 2008 and March 2010 were used.

Methods: After bivariate analyses, multivariate Poisson and logistic regression models were used to estimate the effect of sex on the number of general practitioner (GP) and medical specialist appointments, prescribed medications, hospitalizations, and inpatient rehabilitations, with additional consideration of glycemic control levels. Poor glycemic control (PGC) was defined as glycated hemoglobin ≥7.5%.

Results: In total, 905 participants had acceptable glycemic control and 237 participants had poor glycemic control. PGC was more prevalent in men than in women (23% vs 18%). Bivariate analyses among participants with PGC showed significantly fewer GP and medical specialist appointments, a lower number of medications, and longer rehabilitation stays in men than in women. Multivariate regression analyses among participants with PGC confirmed statistically significant gender differences for GP appointments and number of prescribed medications (P <.05) for men compared with women. Gender differences regarding inpatient care were less evident.

Conclusions: Our data disclosed major gender differences in healthcare utilization of diabetes patients in Germany despite a high DMP-DM rate. Future research should focus attention on gender-specific approaches to healthcare delivery to improve quality and access to care.

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For author information and disclosures, see end of text.

Diabetes accounts for a large share of excess morbidity and mortality globally.[1] Patients with type 2 diabetes mellitus (T2DM) are more susceptible to macro- or microangiopathic complications, such as myocardial infarction (MI), stroke, and peripheral arterial occlusive disease, than people without T2DM.[2] During the last decade, differences between men and women with T2DM have been intensively investigated, revealing a lower quality of life and mental well-being in women than in men, as well as a shorter survival in diabetic women than in diabetic men after acute MI.[3,4] Since glycemic control and diabetes-related complications are associated with healthcare utilization, the individual glycemic status has to be continuously checked in order to prevent an increase in comorbidity.[5]

Healthcare utilization seems to be higher among women than among men, especially at younger ages.[6,7] Although there are analyses of the association between healthcare utilization and T2DM, studies analyzing disparities between men and women are still rare.[8,9] Generally, it is assumed that T2DM-specific disease management programs (DMP-DM) by sickness insurance funds improve outcome and process quality of medical care and limit gender-specific utilization differences due to their managing character.[10] Although it was shown that DMP-DM improve process quality in Germany,[10] gender differences in quality of life between DMP-DM patients remain.[11]

The primary aim of this study was to investigate gender differences in healthcare utilization of patients with T2DM in Germany participating in large part in DMP-DM of sickness insurance funds with additional consideration of quality of glycemic control.

METHODS

Study Design and Study Population

This analysis was based on data from the baseline examination of the DIANA study (Type 2 Diabetes Mellitus: New Approaches to Optimize Medical Care in General Practice), an epidemiological prospective cohort study of patients with T2DM conducted in the Ludwigsburg-Heilbronn area located in southwest Germany. The study was initiated in 2008 to address (short- and long-term) diabetes-related outcomes and to evaluate potential for health services improvements in patients with T2DM. Participants 18 years

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and older with physician-diagnosed T2DM were recruited according to a standardized protocol by 38 general practitioners (GPs) during regular practice visits between October 2008 and March 2010. The study protocol was approved by the Ethics Committees of the medical faculty of the University of Heidelberg (reference S186/2008) and of the Chamber of Physicians of Baden-Württemberg (reference B-2008-168).

Take-Away Points

Cross-sectional analyses of baseline data of a large cohort study of patients with type 2 diabetes mellitus (T2DM) of whom 80% were enrolled in a T2DM-specific disease management program (DMP-DM) were performed to investigate gender differences in healthcare utilization.

- The number of general practitioner appointments and the number of prescribed medications were significantly lower in men than in women with glycated hemoglobin ≥7.5%.
- Gender differences regarding inpatient care were far less evident.
- Health authorities should concentrate on gender-specific healthcare differences being still inherent in DMP-DM in order to improve quality of healthcare.

Inclusion criteria for patients were prevalent T2DM, a visit to one of the participating study practices between October 2008 and March 2010, and sufficient knowledge of the German language. We excluded nursing home residents as well as patients seen by the general practitioners for palliative or emergency care only. A total of 1146 unselected patients with physician-diagnosed T2DM gave written informed consent and completed a self-administered standardized questionnaire at baseline. Medical information was obtained from the GPs by a standardized questionnaire, and a blood sample was collected by the recruiting physicians for glycated hemoglobin (A1C) measurement. A1C was assessed by a central laboratory, using ion-exchange high-pressure liquid chromatography (HPLC) (G8, Tosoh Biosciences).

Definition of Key Variables

This analysis was based on data collected from patients' and physicians' questionnaires at baseline and the A1C levels reported by the cooperating central laboratory.

The covariates, such as age at time of recruitment, gender, level of school education, marital status, place of residence, living condition, occupational status, smoking history, and alcohol consumption, were obtained from the participant questionnaire. To estimate general health status, the first question of the short-form-12 (SF-12) questionnaire ("In general, would you say your health is … ?"; response categories "poor," "fair," "good," "very good," and "excellent") was used.[12]

Information on diabetes duration, participation in a DMP-DM, body mass index (BMI) (kg/m^2), and total number of prescribed medications (diabetes medications and other medications combined) was taken from the physician questionnaire.

Information on prevalent comorbidities including hypertension, hypercholesterolemia, coronary heart disease, heart failure, MI, stroke, intermittent claudication, diabetic retinopathy, diabetic neuropathy, diabetic nephropathy, depression, and cancer was taken from the physician questionnaire. In the few cases (3.8%) where no medical information was available from the GPs, information was taken from the participant questionnaire. Prevalent coronary heart disease including history of myocardial infarction or stroke, heart failure, and intermittent claudication was summarized as cardiovascular disease.

According to the recommendations of the International Diabetes Federation (IDF), glycemic control was classified by an A1C level ≥7.5% indicating poor glycemic control (PGC).[13] This classification is commonly used worldwide in order to anticipate the level of diabetes progression; ie, T2DM patients with an A1C level ≥7.5% have a poorer disease prognosis.

Our primary outcomes were the number of outpatient appointments with general practitioners or with medical specialists within the last 3 months as well as total numbers of prescribed medications, hospitalizations, and inpatient rehabilitations including length of stay (in days) within the last 12 months. The information was available from the patient questionnaire.

Statistical Analysis

Descriptive statistics included means and proportions, respectively, on participants' characteristics and healthcare utilization stratified by gender and glycemic control. Differences between groups were tested for statistical significance by 2-sided *t* tests and χ^2 tests. The Wilcoxon rank sum test was used to evaluate hospitalization and rehabilitation length of stay (2-tailed), including only patients who reported a stay. We used Poisson regression models to fit outpatient appointments (count data) or total number of prescribed medication and A1C measurements. Poisson regression returns (unadjusted and adjusted) rate ratios (RRs). Furthermore, logistic regression models were used to estimate (unadjusted and adjusted) odds ratios (ORs) for hospitalization or rehabilitation stay within the last 12 months (dichotomous) and glycemic control status (A1C level). The multivariate Poisson and logistic models were adjusted for variables selected by backward selection ($P < .1$) in order to identify the main independent determinants. Furthermore, effect modification by glycemic status was assessed using the Breslow-Day test. For statistical testing, an alpha level of 5% was applied, and 95% confidence

Table 1. Study Population Characteristics

Variables of interest	Men (n = 624; 54.5%)	Women (n = 522; 45.5%)	A1C <7.5% (n = 905; 79.3%) Men (n = 480)	A1C <7.5% (n = 905; 79.3%) Women (n = 425)	A1C ≥7.5% (n = 237; 20.7%) Men (n = 144)	A1C ≥7.5% (n = 237; 20.7%) Women (n = 93)
Age in years (mean, SD)[a]	**67.2 (10.1)**	**69.7 (10.4)**	**68.2 (9.5)**	**69.9 (10.3)**	**63.6 (11.1)**	**68.8 (10.8)**
Years since diabetes diagnosis (mean, SD)	8.9 (7.2)	8.8 (7.2)	8.5 (7.0)	8.1 (7.0)	10.2 (7.6)	11.8 (7.4)
Disease management program, n (%)	471 (79.4)	394 (81.6)	362 (79.4)	319 (81.2)	109 (79.6)	75 (83.3)
Comorbidities (physician diagnosed)						
Hypertension, n (%)	488 (78.3)	407 (78.1)	373 (77.9)	331 (77.9)	115 (79.9)	72 (78.3)
Hypercholesterolemia, n (%)	350 (56.2)	300 (57.8)	265 (55.3)	242 (57.2)	85 (59.0)	56 (60.9)
Coronary heart disease, n (%)	**142 (22.8)**	**66 (12.7)**	**105 (21.9)**	**48 (11.3)**	37 (25.7)	18 (19.6)
Myocardial infarction, n (%)	**74 (11.9)**	**23 (4.4)**	**59 (12.3)**	**17 (4.0)**	15 (10.4)	6 (6.5)
Heart failure, n (%)	75 (12.0)	64 (12.3)	61 (12.7)	54 (12.7)	14 (9.7)	9 (9.8)
Intermittent claudication, n (%)	**96 (15.4)**	**36 (6.9)**	**69 (14.4)**	**26 (6.1)**	27 (18.8)	10 (10.9)
Stroke, n (%)	**47 (7.5)**	**22 (4.2)**	**39 (8.1)**	**20 (4.7)**	8 (5.6)	2 (2.2)
Diabetic retinopathy, n (%)	51 (8.2)	35 (6.7)	32 (6.7)	22 (5.2)	19 (13.2)	12 (13.0)
Diabetic neuropathy, n (%)	144 (23.1)	104 (20.0)	105 (21.9)	76 (17.9)	39 (27.1)	28 (30.4)
Diabetic nephropathy, n (%)	**76 (12.2)**	**45 (8.6)**	49 (10.2)	35 (8.2)	27 (18.8)	10 (10.9)
Depression, n (%)	**67 (10.7)**	**97 (18.6)**	**48 (10.0)**	**77 (18.1)**	19 (13.2)	18 (19.6)
Cancer, n (%)	63 (10.1)	49 (9.4)	53 (11.0)	43 (10.1)	10 (6.9)	6 (6.5)
General health status						
Excellent or very good, n (%)	62 (10.0)	40 (7.7)	48 (10.0)	35 (8.2)	14 (9.8)	4 (4.3)
Good, n (%)	366 (58.6)	289 (55.8)	206 (59.6)	240 (56.5)	70 (55.9)	49 (52.7)
Fair, n (%)	174 (27.9)	170 (32.8)	132 (27.5)	135 (31.8)	42 (29.4)	35 (37.6)
Poor, n (%)	21 (3.4)	19 (3.7)	14 (2.9)	15 (3.5)	7 (4.9)	4 (4.3)
Body mass index, kg/m² (mean, SD)	30.3 (5.4)	30.6 (6.2)	29.7 (5.1)	30.1 (6.0)	32.3 (6.0)	32.6 (7.0)
Alcohol consumption						
Abstainer, n (%)	**139 (22.3)**	**282 (54.4)**	**101 (21.0)**	**223 (52.5)**	**38 (26.4)**	**59 (63.4)**
Other, n (%)	**485 (77.7)**	**236 (45.6)**	**379 (79.0)**	**202 (47.5)**	**106 (73.6)**	**34 (36.6)**
Smoking history						
Never smoker, n (%)	**174 (28.0)**	**372 (72.0)**	**139 (29.1)**	**311 (73.2)**	**35 (24.3)**	**61 (66.3)**
Ex-smoker, n (%)	**355 (57.2)**	**99 (19.2)**	**274 (57.4)**	**77 (18.1)**	**81 (56.3)**	**22 (23.9)**
Current smoker, n (%)	**92 (14.8)**	**46 (8.8)**	**64 (13.4)**	**37 (8.7)**	**28 (19.4)**	**9 (9.8)**
Education						
≤9 years at school, n (%)	**433 (70.9)**	**392 (76.9)**	**344 (73.5)**	**323 (77.5)**	**89 (62.2)**	**69 (74.2)**
10-12 years at school, n (%)	**104 (17.0)**	**93 (18.2)**	**72 (15.4)**	**72 (17.3)**	**32 (22.4)**	**21 (22.6)**
≥13 years at school, n (%)	**74 (12.1)**	**25 (4.9)**	**52 (11.1)**	**22 (5.3)**	**22 (15.4)**	**3 (3.2)**
Marital status						
Single, n (%)	**112 (18.1)**	**208 (40.3)**	**72 (15.1)**	**162 (38.3)**	**40 (27.8)**	**46 (49.5)**
Married, n (%)	**508 (81.9)**	**308 (59.7)**	**404 (84.9)**	**261 (61.7)**	**104 (72.2)**	**47 (50.5)**
Place of residence						
Rural, n (%)	280 (44.9)	216 (41.4)	221 (46.0)	173 (40.7)	59 (41.0)	40 (43.0)
Urban, n (%)	344 (55.1)	306 (58.6)	259 (54.0)	252 (59.3)	85 (59.0)	53 (57.0)
Living condition						
Alone, n (%)	**53 (8.8)**	**94 (18.3)**	**39 (8.4)**	**75 (17.9)**	**14 (10.1)**	**18 (19.8)**
With at least 1 person, n (%)	**548 (91.2)**	**421 (81.7)**	**423 (91.6)**	**345 (82.1)**	**125 (89.9)**	**73 (80.2)**
Occupational status						
Employed, n (%)	**158 (26.5)**	**77 (15.6)**	**101 (22.1)**	**62 (15.3)**	**57 (40.7)**	**15 (16.7)**
Retired, n (%)	**403 (67.5)**	**317 (64.0)**	**330 (72.2)**	**262 (64.7)**	**73 (52.1)**	**55 (61.1)**
Housewife, n (%)	**0 (0)**	**79 (16.0)**	**0 (0)**	**67 (16.5)**	**0 (0)**	**12 (13.3)**
Other, n (%)	**36 (6.0)**	**22 (4.4)**	**26 (5.7)**	**14 (3.5)**	**10 (7.1)**	**8 (8.9)**

A1C indicates glycated hemoglobin; SD, standard deviation.
[a]SD number may not always add up to total because of missing values for some items.
Significant results (P <.05) by t test or χ^2 test comparing either patients with an A1C <7.5% with patients with an A1C ≥7.5% or men with women are printed in bold.

Table 2. Healthcare Utilization by Glycemic Control and Gender

Variables of interest	Men (n = 624; 54.5%)	Women (n = 522; 45.5%)	A1C <7.5% (n = 905; 79.3%) Men (n = 480)	A1C <7.5% (n = 905; 79.3%) Women (n = 425)	A1C ≥7.5% (n = 237; 20.7%) Men (n = 144)	A1C ≥7.5% (n = 237; 20.7%) Women (n = 93)
Number of general practitioner appointments (last 3 months) (mean, SD)[a]	2.5 (2.4)	2.6 (2.5)	2.5 (2.2)	2.5 (2.1)	**2.4 (2.9)**	**3.3 (3.0)**
Number of medical specialist appointments (last 3 months) (mean, SD)	1.0 (1.6)	1.1 (1.5)	1.1 (1.6)	1.1 (1.5)	**0.8 (1.3)**	**1.2 (1.5)**
Medical specialist appointment (last 3 months)						
Yes	**319 (51.1)**	**301 (57.9)**	255 (53.1)	245 (57.9)	**64 (44.4)**	**54 (58.1)**
No	**305 (48.9)**	**219 (42.1)**	225 (46.9)	178 (42.1)	**80 (55.6)**	**39 (41.9)**
Total number of prescribed medications (current) (mean, SD)	**5.7 (2.6)**	**6.1 (2.5)**	5.7 (2.6)	6.0 (2.6)	**5.8 (2.6)**	**6.8 (2.3)**
Hospitalization (last 12 months)						
Yes	106 (17.0)	89 (17.1)	82 (17.1)	64 (15.1)	24 (16.7)	23 (24.7)
No	518 (83.0)	433 (82.9)	398 (82.9)	361 (84.9)	120 (83.3)	70 (75.3)
Number of days in hospital (last 12 months) (mean, SD)[b]	13.4 (16.4)	15.5 (14.9)	13.0 (16.6)	16.2 (16.1)	15.0 (16.1)	14.4 (11.4)
Rehabilitation (last 12 months)						
Yes	52 (8.3)	45 (8.6)	39 (8.1)	38 (9.0)	13 (9.0)	7 (7.5)
No	572 (91.7)	477 (91.4)	441 (91.9)	387 (91.0)	131 (91.0)	86 (92.5)
Number of days in rehabilitation (last 12 months) (mean, SD)[c]	**19.9 (9.5)**	**26.4 (17.6)**	**18.4 (7.0)**	**24.8 (13.9)**	24.4 (14.0)	35.0 (31.0)

A1C indicates glycated hemoglobin; SD, standard deviation.
[a]SD number may not always add up to total because of missing values for some items.
Significant results (P <.05) by t test, χ^2 test, or Wilcoxon rank sum test comparing either patients with an A1C <7.5% with patients with an A1C ≥7.5% or men with women are printed in bold.
[b]Refers to the participants reporting a hospital stay.
[c]Refers to the participants reporting a rehabilitation stay.

intervals (CIs) calculated. SAS 9.2 (SAS Institute, Cary, North Carolina) was used throughout.

RESULTS

Overall, 624 men (54.5%) and 522 women (45.5%) participated in this study (Table 1). About 23% of the men and 18% of the women had PGC. Men were significantly younger than women (mean age ± standard deviation [SD]: men: 67.2 ± 10.1 years; women: 69.7 ± 10.4 years). In the PGC group, men were on average 5 years younger than women (men: 63.6 ± 11.1 years; women: 68.8 ± 10.8 years). Diabetes duration (measured in years since diabetes diagnosis) was similar for men (8.9 ± 7.2 years) and women (8.8 ± 7.2 years). Participation in a disease management program was slightly less common in men than in women (79.4% vs 81.6%).

There were statistically significant differences between men and women concerning physician-diagnosed comorbidities: men showed a higher prevalence of coronary heart disease, myocardial infarction, intermittent claudication, stroke, and nephropathy than women, whereas women more often had a diagnosed depression than men. The self-reported general health status did not differ between men and women —even if PGC status was considered. The mean BMI was almost identical between men and women. Alcohol consumption was far more common in men (77.7%) than in women (45.6%). Similarly, current smoking was more often reported by men than by women (14.8% vs 8.8%).

Overall, the vast majority of patients had completed up to 9 years of school education (72.2%). More men than women had completed 13 years or more of education. More men than women were still married (81.9% vs 59.7%). About 9% of all men but 18% of all women reported living alone. The majority of the patients were already retired (63%). Employment was more common in men, especially in the group with PGC (40.7% vs 16.7%).

■ **Table 3.** Results of Poisson Regression to Fit Outpatient Treatment: Rate Ratios (95% Confidence Intervals) for Men Compared With Women

		Total (n = 1142)	A1C <7.5% (n = 905)	A1C ≥7.5% (n = 237)
General practitioner appointment	Crude	0.94 (0.84-1.05)	1.00 (0.90-1.12)	0.73 (0.56-0.96)
	Adjusted[a]	0.95 (0.86-1.06)	—	—
	Adjusted[b]	0.97 (0.86-1.08)	—	—
	Adjusted[c]	—	1.02 (0.91-1.14)	0.75 (0.55-1.02)
	Adjusted[d]	—	1.06 (0.94-1.20)	0.70 (0.53-0.91)
Medical specialist appointment	Crude	0.90 (0.76-1.06)	0.96 (0.80-1.15)	0.70 (0.49-0.99)
	Adjusted[a]	0.90 (0.76-1.06)	—	—
	Adjusted[b]	0.83 (0.69-1.00)	—	—
	Adjusted[c]	—	0.95 (0.79-1.14)	0.73 (0.51-1.03)
	Adjusted[d]	—	0.84 (0.69-1.02)	0.85 (0.54-1.35)
Prescribed medication	Crude	0.94 (0.89-0.99)	0.96 (0.90-1.02)	0.85 (0.77-0.94)
	Adjusted[a]	0.95 (0.91-1.00)	—	—
	Adjusted[c]	—	0.97 (0.92-1.03)	0.89 (0.80-0.98)
	Adjusted[e]	0.94 (0.89-0.99)	—	—
	Adjusted[f]	—	0.96 (0.90-1.02)	0.89 (0.80-0.99)

A1C indicates glycated hemoglobin.
[a]Adjusted for age and A1C level.
[b]Adjusted for age, A1C level, cardiovascular disease, depression, general health status, marital status, place of residence, and occupational status.
[c]Adjusted for age.
[d]Adjusted for age, cardiovascular disease, depression, general health status, marital status, place of residence, and occupational status.
[e]Adjusted for age, A1C level, cardiovascular disease, nephropathy, depression, general health status, body mass index, alcohol, and occupational status.
[f]Adjusted for age, cardiovascular disease, nephropathy, depression, general health status, body mass index, alcohol, and occupational status.

The mean total number (± standard deviation) of GP appointments during the last 3 months was 2.5 ± 2.4 for men and 2.6 ± 2.5 for women, respectively (Table 2). Among patients with PGC, men had on average significantly fewer appointments with their GPs or medical specialists than women (GP appointments: men: 2.4 ± 2.9, women: 3.3 ± 3.0; medical specialist appointments: men: 0.8 ± 1.3, women: 1.2 ± 1.5) (GP: P = .03; medical specialist: P = .05). The mean total number of prescribed medications was 5.7 ± 2.6 in men and 6.1 ± 2.5 in women, respectively. A statistically significant gender difference in prescribed medication was evident in the group of patients with PGC: women received more medication than men (men: 5.8 ± 2.6, women: 6.8 ± 2.3, P = .0002).

About 17% of the participants reported a hospitalization during the last 12 months. There were small, non-significant gender differences in regard to hospitalization in the respective PGC groups: more women (24.7%) than men with PGC (16.7%) were hospitalized, but men with PGC stayed on average about 1 day longer in the hospital than women with PGC. In the group of patients with an A1C<7.5%, hospitalized women stayed on average 3 days longer in the hospital than men.

Overall, about 8% of the men and 9% of the women reported a rehabilitation stay during the last 12 months. In the group of patients with PGC, women stayed on average 11 days longer than men, and in the group with an A1C<7.5%, women who had a rehabilitation stayed on average 6 days longer than men (P = .01).

Table 3 shows the results of the Poisson regression analyses of the outpatient care setting: overall, GP appointments of men and women seemed to be very similar. However, after stratification for glycemic status and full adjustment for the aforementioned covariates, men had significantly fewer GP appointments than women (fully adjusted RR = 0.70, 95% CI: 0.53-0.91) in the PGC group but not in the non-PGC group.

Men, in general, had fewer specialist appointments than women (fully adjusted RR = 0.83; 95% CI: 0.69-1.00). This trend was similar for both glycemic control groups: for patients with an A1C <7.5% (fully adjusted RR = 0.84, 95% CI: 0.69-1.02) and for patients with PGC (fully adjusted RR = 0.85, 95% CI: 0.54-1.35).

We found a lower medication rate in men than women. This difference persisted after control for covariates including comorbidities in the fully adjusted model (fully adjusted RR = 0.94; 95% CI: 0.89-0.99). Also, among patients with PGC, we observed a statistically significant gender difference (fully adjusted RR = 0.89; 95% CI: 0.80-0.99).

Table 4 shows the results of logistic regression analyses for the inpatient care setting. No significant variation by gender was found, neither for hospitalization nor for rehabilitation (hospitalization: fully adjusted OR for men compared with women = 0.92; 95% CI: 0.65-1.29; rehabilitation: fully adjusted OR = 0.84; 95% CI: 0.54-1.32). Also, no significant association was found after stratification for glycemic status.

Table 4. Results of Logistic Regression to Fit Hospitalization and Rehabilitation: Odds Ratios (95% Confidence Intervals) for Men Compared With Women

		Total (n = 1142)	A1C <7.5% (n = 905)	A1C ≥7.5% (n = 237)
Hospitalization	Crude	1.00 (0.73-1.36)	1.15 (0.81-1.64)	0.59 (0.30-1.16)
	Adjusted[a]	1.05 (0.76-1.44)	—	—
	Adjusted[b]	0.92 (0.65-1.29)	—	—
	Adjusted[c]	—	1.20 (0.84-1.72)	0.66 (0.34-1.28)
	Adjusted[d]	—	1.01 (0.68-1.50)	0.71 (0.34-1.45)
Rehabilitation	Crude	0.96 (0.64-1.46)	0.90 (0.50-1.55)	1.28 (0.46-3.55)
	Adjusted[a]	0.92 (0.60-1.40)	—	—
	Adjusted[b]	0.84 (0.54-1.32)	—	—
	Adjusted[c]	—	0.89 (0.56-1.43)	1.04 (0.39-2.77)
	Adjusted[d]	—	0.86 (0.52-1.42)	1.02 (0.35-2.97)

A1C indicates glycated hemoglobin.
[a]Adjusted for age and A1C level.
[b]Adjusted for age, A1C level, diabetes duration, cardiovascular disease, depression, cancer, general health status, and place of residence.
[c]Adjusted for age.
[d]Adjusted for age, diabetes duration, cardiovascular disease, depression, cancer, general health status, and place of residence.

There was no effect modification by glycemic status for outpatient or inpatient healthcare utilization (Breslow-Day test or Cochran-Mantel-Haenszel statistics: P >.05).

DISCUSSION

In this cohort of patients with T2DM recruited in the primary care setting in Germany, we found a higher cardiovascular comorbidity in men, whereas women suffered more often from depression, irrespective of quality of glycemic control and self-reported general health status. Analyzing the healthcare utilization in outpatient and inpatient care settings, we found no or marginal differences between men and women regarding the number of GP and medical specialist appointments, the number of prescribed medications, hospitalization, and rehabilitation. However, after stratifying for glycemic control, in the group of patients with PGC, men had significantly lower numbers of GP appointments and numbers of prescribed medications than women.

Compared with women without PGC, women with PGC had higher rates of prevalent comorbidities, like coronary heart disease, intermittent claudication, and diabetic retinopathy or neuropathy, and therefore differences between men and women in prevalences were less pronounced in the group of patients with PGC than in the group without PGC. A higher number of comorbidities, either diabetes-related or non–diabetes-related, has been associated with an increase of healthcare use,[14] but previous studies also highlighted the fact that a higher burden of disease and a lower general health status leads to a stronger increase of healthcare utilization in women than in men.[6] Female perception of illnesses is different from the male and it is more culturally and socially accepted for women to be ill and seek professional help than it is for men.[15] However, Christensen et al recently showed that in the elderly, gender-specific differences are generally less evident since the need for healthcare services might be similarly high in old men and women due to an increase of chronic diseases and frailty with age.[16]

A lower healthcare utilization in men compared with women with PGC might also be explained by socioeconomic factors: previous investigations found an association between a higher healthcare utilization and a lower socioeconomic status[17,18] and a single marital status rate,[19] which is mostly the case in women. Differences in education between men and women were more pronounced in the PGC group than in the group with good glycemic control, and the highest rate of single status was found among women with PGC. Overall, socioeconomic factors might contribute to healthcare utilization, but may influence healthcare utilization less than individual health status and quality of life.[20]

In general, our finding of a lower healthcare utilization of men than of women is in accordance with previous international examinations either with unselected populations or with diabetes patients[7,8,21]: our results in the outpatient care setting confirm current statistics in Germany, for example on GP appointments showing a strong discrepancy between men and women and indicating a potential overutilization by women, especially in those with PGC.[22] However, we could not confirm the finding of an analysis from Finland and Norway showing a higher inpatient care use among women than among men.[23] This may be due to the very low numbers of hospitalizations and rehabilitations of our study population.

A higher medication prescription rate in women compared with men, but higher inpatient costs in men than in women, were also previously described by Stock et al using data of a large German statutory health insurance focusing on 6 chronic diseases including diabetes.[24] It is also in concordance with McFarlane et al and Wexler et al, indicating that women with diabetes are treated less aggressively compared with diabetic men when cardiovascular comorbidities are considered, although the prescription rate is often higher in women than in men.[25,26]

This study was the first analyzing total and gender-specific associations between different categories of healthcare utilization and glycemic status defined by A1C. A major strength is the comprehensive adjustment for numerous important covariates. Information was generated by participants and physician questionnaires and A1C tests. The data quality was overall high with a very low rate of missing values, and crucial information about diabetes, eg, prevalent comorbidities, diabetes duration, and prescribed medications, is assumed as valid since this information was obtained from the physicians. Furthermore, the almost equal distribution of men and women in our study population allowed gender-stratified analyses.

To our knowledge, no previous study has examined gender differences in healthcare utilization (ie, outpatient care visits, medication use, hospitalization, and rehabilitation) and glycemic control (measured by A1C) among diabetes patients in Germany while simultaneously adjusting for a wide range of important covariates.

Limitations of the study need to be considered in interpreting the results. First, the information on outpatient appointments and on hospital and rehabilitation length of stay was taken from the participant questionnaire, as the GPs were not asked for this information. Therefore, underreporting might be possible, as it is known that women tend to report healthcare use more carefully because being ill is culturally more accepted for women than for men.[15] We also had no information on the reasons for hospitalization or rehabilitation which might explain differences in the length of stay between men and women. Furthermore, lack of statistical significance in some of the analyses, especially in inpatient care, might be explained by sample size limitations rather than a lack of association.

Since this is a cross-sectional analysis, causality of PGC and healthcare utilization cannot be determined. Furthermore, we could not differentiate by health insurance status, which has been shown to influence healthcare utilization.[27] However, since more than 80% of the study participants attend a DMP-DM and more than 90% of the German population is generally insured by a statutory health insurer, our population mainly represents publicly insured patients with T2DM in Germany.

Our study documents the need to further understand the gender-specific complex and possibly synergistic effect of diabetes, its risk factors, and its comorbidities on healthcare utilization. Health authorities should concentrate on gender-specific differences in order to improve both process and outcome quality of healthcare, especially the oversupply of outpatient care in women compared with men with T2DM. Examples might include introducing gender-focused diabetes treatment and training programs offered by statutory health insurances. Future research should focus on gender differences in the access to healthcare and its potential effect on diabetes progression.

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