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High-Risk Diabetic and Non-Diabetic Patients in Primary Health Care: Comparison and Associated Factors

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Abstract

Background/Objectives: An increasing proportion of patients with Type 2 diabetes mellitus (T2DM) are classified as high risk, often presenting with multimorbidity, functional vulnerability, and complex treatments. This study compared the sociodemographic, functional, clinical, therapeutic, and healthcare utilization profiles of high-risk chronic patients with and without T2DM in primary health care. **Methods**: A cross-sectional study included adults classified as high-risk chronic patients in primary health care electronic health records in the Madrid Region (30 April 2021). Sociodemographic, functional, clinical, lifestyle, pharmacological variables, and primary health care services utilization were analyzed. Multivariate logistic regression identified factors independently associated with T2DM. **Results**: Among 163,188 high-risk chronic patients, 41.5% had T2DM. Patients with T2DM were older, more often male, and had a comparable deprivation index values to non-diabetic patients. They showed higher functional dependency and greater need for informal caregiving. Clinically, patients with T2DM had a higher burden of chronic conditions and a predominance of cardiometabolic, hematological and renal comorbidities, whereas non-diabetic patients exhibited more neuropsychiatric, chronic infectious, oncological and respiratory profiles. Polypharmacy was more frequent in T2DM patients, who also showed lower medication adherence. In the explanatory model, older age (OR 1.02/year), cardiometabolic comorbidities (ORs ~1.2–1.6), highest quartile of morbidity complexity (OR 1.27), polypharmacy (OR 1.34), and concern about medications (OR 1.08) were associated with T2DM, while female sex (OR 0.660), depression (OR 0.888), COPD (0.704), neoplasms (0.688), and higher medication adherence (OR 0.53) were associated with not having T2DM. **Conclusions**: High-risk chronic patients with T2DM exhibit distinct sociodemographic, functional, and clinical profiles compared with those without T2DM, characterized by greater complexity, cardiometabolic burden, therapeutic intensity and use of healthcare services, supporting the need for tailored, integrated primary health care strategies.

Keywords: diabetes mellitus; type 2; chronic disease; multimorbidity; medication adherence; risk assessment; primary health care

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1. Introduction

Diabetes mellitus is a major public health problem worldwide due to its high prevalence, chronicity, and associated complications. Effective management requires long-term adherence to treatment and active patient self-management, representing a significant burden for healthcare systems, particularly in primary health care settings. Globally, over 589 million adults are affected, with type 2 diabetes mellitus (T2DM) accounting for most cases. The disease is associated with increased morbidity and mortality, primarily due to cardiovascular disease, chronic kidney disease, and retinopathy [1].

Chronic diseases more broadly represent one of the greatest challenges for global public health and are a leading cause of healthcare burden both in Europe and in Spain. The World Health Organization defines them as "diseases of long duration and generally slow progression, including cardiovascular diseases, cancer, chronic respiratory diseases, and diabetes mellitus" [2]. Their prevalence has increased significantly due to population aging and advances in diagnostic and therapeutic methods [3]. Common features include persistence over time, the need for continuous treatment, and a negative impact on quality of life [4]. Consequently, improving the efficiency of chronic disease management has become a priority, particularly in primary health care, through strategies such as risk stratification, proactive approaches to patient management, individualized care planning, and optimized allocation of healthcare resources, supported by a detailed understanding of clinical and sociodemographic profiles [5].

To guide healthcare planning and resource allocation, morbidity groupers have emerged as key tools for proactive patient management and the improved integration of healthcare services [6]. In Spain, Adjusted Morbidity Groups, integrated into primary health care electronic health records in most Autonomous Communities, classify patients into four risk levels—no risk, low, medium, and high—based on morbidity and clinical complexity [7,8]. This approach is particularly relevant for high-risk patients with diabetes mellitus, given their elevated risk of complications and hospitalizations. In Spain, around 14% of adults have diabetes, with more than 5 million people affected, many undiagnosed [1].

Although diabetes has been widely investigated, population-based evidence focusing on high-risk patients managed in primary health care remains limited, particularly regarding clinical complexity, functional status, and patterns of healthcare utilization. This study was conducted as a sub-study within the European H2020–IMI project BEAMER (BEhavioral and Adherence Model for improving quality, health outcomes and cost-Effectiveness of healthcaRe), which aims to develop a comprehensive model to understand and predict therapeutic adherence behaviors across different healthcare settings [9]. Within this framework, accurately characterizing the profile of high-risk patients with diabetes provides essential information to improve adherence and reduce the associated healthcare burden.

Therefore, the objective of this study was to characterize high-risk patients with T2DM in primary health care and to compare them with high-risk patients without T2DM in terms of sociodemographic, functional, and clinical characteristics, treatments, and primary health care service utilization, as well as to identify factors independently associated with the presence of T2DM.

2. Materials and Methods

2.1. Study Design

This was a cross-sectional descriptive study.

2.2. Study Population and Participant Selection

All adults (≥18 years) identified by the Adjusted Morbidity Groups as high-risk patients with chronic diseases in the primary health care electronic health records of the Madrid Health Service as of 30 April 2021, were eligible for inclusion. Patients classified as medium, low, or without risk in the primary health care electronic record were excluded [10]. The study was conducted in the Community of Madrid (Spain), which had a population of 6,751,251 inhabitants as of 1 January 2021 [11,12].

2.3. Data Collection

Secondary data were obtained from primary health care electronic health records and pharmacy dispensing records. The data were extracted and anonymized by the Technical Directorate of Information Systems of Primary Care Management, while pharmaceutical data were provided by the Directorate General of Economic-Financial Management and Pharmacy of the Madrid Health Service (SERMAS).

2.4. Variables

The dependent variable was a diagnosis of T2DM, identified in primary health care electronic health records using the T90 code from the International Classification of Primary Care, Second Edition (ICPC-2) [13]. This code includes patients with a clinical diagnosis of T2DM recorded by their primary health care physician, regardless of treatment modality. Explanatory variables were grouped into six blocks (Table S1):

(1) Sociodemographic variables: age, sex, foreign status, continent of birth, deprivation index, individual health card (TSI)—copayment category [14,15], number of household members, and household composition.

(2) Functional variables: functional status [16], living situation, and needs of care by primary caregiver (presence and type of primary caregiver) and/or palliative care.

(3) Clinical variables: Adjusted Morbidity Groups complexity index [7,8], number of chronic diseases, multimorbidity, disease category and type of chronic disease identified through the Adjusted Morbidity Groups system.

(4) Lifestyle variables: substance use behaviors (tobacco, alcohol, illicit drugs, and medication abuse), physical activity, Mediterranean diet, perceived stress, sleeping habits, and risk of sexually transmitted infections.

(5) Pharmacological variables: total number of medications, polypharmacy, Anatomical Therapeutic Chemical (ATC) classification, medication adherence, concerns about medication, adverse drug reactions, and treatment-related complications [17–19].

(6) Annual PHC service utilization: total contacts, professional contacted and form of contact.

All explanatory variables were obtained from primary health care electronic health records and routinely recorded by primary health care professionals as binary variables (Yes/No), following standardized protocols for the documentation of clinical episodes and health promotion and disease prevention activities.

All variables were assessed at baseline, corresponding to the date of data extraction. Primary health care service utilization was recorded for the period between 30 April 2021, and 30 April 2022.

2.5. Statistical Analyses

Descriptive statistics were calculated: categorical variables were expressed as frequencies and percentages, and quantitative variables as means with standard deviations (SD) and medians with interquartile ranges (IQR). Normality was assessed using the Shapiro–Wilk test. In bivariate analyses, categorical variables were assessed using the

chi-square test or Fisher's exact test, while parametric or non-parametric tests were applied for quantitative and polytomous variables according to data distribution. The Bonferroni correction was applied to adjust for multiple comparisons. A binary logistic regression model was constructed to identify variables independently associated with the presence of T2DM among high-risk chronic patients. Variables were selected a priori based on statistical significance in bivariate analyses and/or clinical and epidemiological relevance and were entered simultaneously using the forced-entry method. The final model prioritized biological plausibility and etiological relevance, acknowledging the multifactorial nature of T2DM. Results were expressed as odds ratios (ORs) with 95% confidence intervals (CIs). Statistical significance was set at $p < 0.05$. Data analysis was performed using IBM SPSS Statistics, version 30 (IBM Corp., Armonk, NY, USA).

3. Results

The final sample comprised 163,188 patients aged 18 years or older, all classified as high clinical risk. Of these, 67,746 patients (41.5%) had T2DM.

3.1. Sociodemographic Characteristics

The mean age of the sample was 77.1 years, with patients with T2DM being slightly older than those without T2DM. Patients with T2DM showed a higher concentration in the 66–80-year age group compared with patients without T2DM patients (44.4% vs. 37.8%), whereas younger age groups were more frequently represented among patients without T2DM ($p < 0.001$). Females predominated in the total sample; however, males were more frequent among patients with T2DM (50.5% vs. 45.2%, $p < 0.001$). Most of the patients were of European origin. Only a small proportion of participants were born outside Europe. Patients with T2DM had a slightly higher representation of African origin (1.0% vs. 0.8%) and a slightly lower representation of American origin (3.2% vs. 3.7%) compared with patients without T2DM ($p < 0.001$). In total, 97.5% of the study population were Spanish nationals. Socioeconomic deprivation showed a broadly similar distribution between groups, with comparable mean and median deprivation index values in patients with and without T2DM, indicating no relevant differences in overall socioeconomic deprivation. In contrast, the distribution of health coverage categories showed some minor differences between groups. Patients with T2DM were slightly more represented in TSI 001 and TSI 002 categories (exempt users, non-contributory pensioners, long-term unemployed, and pensioners), whereas patients without T2DM were slightly more represented in TSI 003 and TSI 004 categories, corresponding to active citizens with intermediate to higher incomes (Table 1).

Table 1. Sociodemographic characteristics of high-risk patients over 18 years in Madrid (overall and by type 2 diabetes status).

Sociodemographic Characteristics n (%)	Total 163,188 (100)	T2DM 67,746 (41.5)	No T2DM 95,442 (58.5)	*p*-Value
Sex				
Female	88,439 (54.2)	33,546 (49.5)	54,893 (57.5)	<0.001
Male	74,749 (45.8)	34,200 (50.5)	40,549 (45.2)	
Age				
Mean (SD)	77.1 (11.8)	77.4 (10.5)	76.9 (12.6)	<0.001
Median (IQR)	79.0 (16)	79.0 (14)	79.0 (16)	

Table 1. *Cont.*

Sociodemographic Characteristics n (%)	Total 163,188 (100)	T2DM 67,746 (41.5)	No T2DM 95,442 (58.5)	*p*-Value
Age				
Age 18–35	621 (0.4)	76 (0.1)	545 (0.6)	<0.001
Age 36–50	3665 (2.2)	838 (1.2)	2827 (3.0)	
Age 51–65	22,207 (13.6)	8480 (12.5)	13,727 (14.4)	
Age 66–80	66,135 (40.5)	30,057 (44.4)	36,078 (37.8)	
Age 81–95	67,356 (41.3)	27,378 (40.4)	39,978 (41.9)	
Age > 95	3204 (2.0)	917 (1.4)	2287 (2.4)	
Foreign				
Yes	4024 (2.5)	1655 (2.4)	2369 (2.5)	0.617
No	159,159 (97.5)	66,086 (97.6)	93,073 (97.5)	
Unknown	5 (<0.001)			
Continent of birth				
Africa	1506 (1.0)	696 (1.0)	810 (0.8)	<0.001
America	5701 (3.5)	2186 (3.2)	3515 (3.7)	
Asia	505 (0.3)	254 (0.4)	251 (0.3)	
Europe	155,452 (95.3)	64,597 (95.4)	90,855 (95.2)	
Oceania	14 (0.0)	5 (0.0)	9 (0.0)	
Unknown	10 (<0.001)			
Privation index				
Mean (SD)	0.1 (1)	0.1 (0.0)	0.1 (0.9)	0.549
Median (IQR)	0.2 (1.3)	0.2 (1.3)	0.2 (1.3)	
1st quartile (Q1, lowest)	40,204 (24.6)	16,677 (24.6)	24,551 (25.7)	<0.001
2nd quartile (Q2)	41,344 (25.3)	17,246 (25.5)	23,810 (24.9)	
3rd quartile (Q3)	41,538 (25.5)	17,501 (25.8)	23,301 (24.4)	
4th quartile (Q4, highest)	40,102 (24.6)	16,322 (24.1)	23,780 (24.9)	
Individual health card income (TSI)—co-payment category				
TSI 1: exempt users (0% co-payment)	48,570 (29.8)	20,248 (29.9)	28,322 (29.7)	<0.001
TSI 2: pensioners (10% co-payment)	99,011 (60.7)	42,121 (62.2)	56,890 (59.6)	
TSI 3: low-income active (40% co-payment)	8640 (5.3)	3021 (4.5)	5619 (5.9)	
TSI 4: middle–high income active (50% co-payment)	659 (2.2)	1052 (1.6)	2607 (2.7)	
TSI 5: highest-income active (60% co-payment)	783 (0.5)	274 (0.4)	509 (0.5)	
TSI 6: mutual insurance (variable co-payment)	1257 (0.8)	459 (0.7)	798 (0.8)	
Others	1268 (0.8)	571 (0.8)	698 (0.7)	

T2DM: Type 2 Diabetes Mellitus; SD: Standard Deviation; IQR: Interquartile Range; TSI: Individual Health Card.

3.2. Functional Characteristics

Regarding functional status, most patients were independent (79.2%), with a slightly higher proportion of dependence among patients with T2DM compared to patients without T2DM (21.7% vs. 20.2%, $p < 0.001$). Similar proportions of patients lived alone in both groups (4.8% vs. 4.2%, $p = 0.343$), while the proportion of immobilized patients was slightly higher among those with T2DM (12.5% vs. 12.0%, $p = 0.006$). In terms of care needs, the

presence of a primary caregiver was more frequent in patients with T2DM compared with patients without T2DM (17.7% vs. 16.1%, $p < 0.001$) (Table 2).

Table 2. Sociofunctional characteristics of high-risk patients over 18 years in Madrid (overall and by type 2 diabetes status).

Sociofunctional Characteristics n (%)	Total 163,188 (100)	T2DM 67,746 (41.5)	No T2DM 95,442 (58.5)	*p*-Value
Functional Status				
Independent	129,273 (79.2)	53,074 (78.3)	76,199 (79.8)	<0.001
Dependent	33,915 (20.8)	14,672 (21.7)	19,243 (20.2)	
Living situation				
Living alone	7232 (4.4)	3232 (4.8)	4000 (4.2)	0.343
Immobilized	19,934 (12.2)	8454 (12.5)	11,480 (12.0)	0.006
Needs of care by primary caregiver or palliative care				
Primary caregiver	27,322 (16.7)	11,966 (17.7)	15,356 (16.1)	
Offspring	10,154 (6.2)	4574 (6.8)	5580 (5.8)	
Partner	6716 (4.1)	3260 (4.8)	3456 (3.6)	
In-home help	2834 (1.7)	1164 (1.7)	1670 (1.7)	<0.001
Parents	104 (0.1)	35 (0.1)	69 (0.1)	
Other relatives	1659 (1.0)	658 (1.0)	1001 (1.0)	
Others	5855 (3.6)	2275 (3.4)	3580 (3.8)	
Palliative care	2695 (1.7)	1006 (1.5)	1689 (1.8)	<0.001

T2DM: Type 2 Diabetes Mellitus.

3.3. Clinical Characteristics

The overall disease burden was high among high-risk chronic patients. The mean and median Adjusted Morbidity Groups complexity index values were similar between patients with and without T2DM (24.7 vs. 23.5 and 22.7 vs. 21.7), although a higher proportion of patients with T2DM were concentrated in the upper complexity quartiles (Q3 and Q4), indicating a greater representation of highly complex cases in the diabetic population. Correspondingly, patients with T2DM had a higher mean number of chronic conditions per patient (8.0) compared with non-diabetic patients (6.9), with an overall mean of 7.3 chronic conditions per patient, all patients being multimorbid. Disease categories revealed two distinct clinical profiles. High-risk chronic patients with T2DM exhibited a cardiometabolic pattern, with higher prevalence of cardiovascular, endocrinological, hematological, and renal conditions. In contrast, patients without T2DM showed a profile characterized by higher prevalence of neurological disorders, mental health conditions, chronic infections, neoplasms, and respiratory diseases. Differences in other disease categories were small or clinically less relevant (Tables 3 and S2).

Table 3. Clinical characteristics of high-risk patients over 18 years in Madrid (total and stratified by presence of T2DM).

Clinical Characteristics n (%)	Total 163,188 (100)	T2DM 67,746 (41.5)	No T2DM 95,442 (58.5)	*p*-Value
Complexity index by Adjusted Morbidity Groups				
Mean (SD)	24.0 (6.3)	24.7 (6.8)	23.5 (5.8)	<0.001
Median (IQR)	22.1 (6.6)	22.7 (7.4)	21.7 (6.0)	
1st quartile (Q1, lowest)	40,811 (25.0)	14,769 (21.8)	26,042 (27.3)	
2nd quartile (Q2)	40,789 (25.0)	15,891 (23.5)	24,898 (26.1)	<0.001
3rd quartile (Q3)	40,792 (25.0)	17,266 (25.5)	23,526 (24.6)	
4th quartile (Q4, highest)	40,796 (25.0)	19,820 (29.3)	20,976 (22.0)	

Table 3. *Cont.*

Clinical Characteristics n (%)	Total 163,188 (100)	T2DM 67,746 (41.5)	No T2DM 95,442 (58.5)	*p*-Value
Number of chronic diseases				
Mean (SD)	7.3 (2.2)	8.0 (2.2)	6.9 (2.2)	<0.001
Median (IQR)	7.0 (3.0)	8.0 (2.0)	7.0 (3.0)	
Multimorbidity (≥2)	163,188 (100)	67,746 (100)	95,442 (100)	-
Disease Categories				
Cardiovascular	157,188 (96.3)	66,722 (98.5)	90,466 (94.8)	<0.001
Digestive and hepatic	31,685 (19.4)	16,939 (25)	23,302 (24.4)	0.007
Endocrine and metabolic	123,275 (75.5)	67,746 (100)	55,529 (58.2)	<0.001
Eye	15,949 (9.8)	7114 (10.5)	8835 (9.3)	<0.001
Genitourinary	33,323 (20.4)	16,139 (23.8)	17,184 (18.0)	<0.001
Hematologic	48,410 (29.7)	22,666 (33.5)	25,744 (27.0)	<0.001
Infectious diseases	13,982 (8.6)	4922 (7.3)	9060 (9.5)	<0.001
Mental and behavioral	54,173 (33.2)	20,882 (30.8)	33,291 (34.9)	<0.001
Musculoskeletal and connective tissue	143,023 (87.6)	59,775 (88.2)	83,248 (87.2)	<0.001
Neurological	86,903 (53.3)	34,711 (51.2)	52,192 (54.7)	<0.001
Oncological	26,549 (16.3)	8538 (12.6)	18,011 (18.9)	<0.001
Respiratory	60,621 (37.2)	23,814 (35.2)	36,807 (38.6)	<0.001

T2DM: Type 2 Diabetes Mellitus; SD: Standard Deviation; IQR: Interquartile Range; Q: Quartile.

3.4. Lifestyle Habits

Regarding substance use behaviors, patients with T2DM showed a lower recorded prevalence of substance use and alcohol abuse compared with patients without T2DM. Tobacco use was slightly more prevalent among patients with T2DM than among patients without T2DM (6.7% vs. 5.6%, $p < 0.001$). Illicit drug abuse was infrequent in both groups, and medication abuse was less common among patients with T2DM. Physical exercise and adherence to the Mediterranean diet were generally low among all high-risk chronic patients, although slightly more frequently recorded in patients with T2DM (physical exercise: 25.6% vs. 22.8%; Mediterranean diet adherence: 41.4% vs. 36.3%, $p < 0.001$). However, more than half of these data were not registered. Information on sleeping habits, stress levels, and risk of sexually transmitted infections was rarely documented in the clinical records (Table 4).

Table 4. Lifestyle habits in high-risk patients over 18 years in Madrid (overall and by type 2 diabetes status).

Lifestyle Habits * n (%)	Total 163,188 (100)	T2DM 67,746 (41.5)	No T2DM 95,442 (58.5)	*p*-Value
Substance use behaviors				
Tobacco use	9917 (6.1)	4564 (6.7)	5353 (5.6)	<0.001
Alcohol abuse	8736 (5.4)	3383 (5.0)	5353 (5.6)	<0.001
Illicit drugs abuse	1405 (0.9)	398 (0.6)	1007 (1.1)	<0.001
Medication abuse	467 (0.3)	158 (0.2)	309 (0.3)	<0.001
Physical exercise				
Yes	39,063 (24.0)	17,315 (25.6)	21,748 (22.8)	<0.001
No	32,660 (20.0)	14,813 (21.9)	17,847 (18.7)	
Unknown	91,465 (56.0)			

Table 4. *Cont.*

Lifestyle Habits * n (%)	Total 163,188 (100)	T2DM 67,746 (41.5)	No T2DM 95,442 (58.5)	*p*-Value
Mediterranean diet				
Yes	62,723 (38.5)	28,043 (41.4)	34,680 (36.3)	<0.001
No	5162 (3.2)	2575 (3.8)	2587 (2.7)	
Unknown	95,303 (58.4)			
Regular stress				
Yes	100 (0.1)	46 (0.1)	54 (0.1)	0.657
No	283 (0.2)	127 (0.2)	156 (0.2)	
Unknown	162,805 (99.7)			
Normal sleeping habit				
Yes	3 (0.0)	2 (0.0)	1 (0.0)	0.341
No	2 (0.0)	1 (0.0)	1 (0.0)	
Unknown	163,183 (99.9)			
Sexually Transmitted Infection Risk				
Yes	76 (0.0)	20 (0.0)	56 (0.1)	0.020
No	3279 (2.0)	1340 (2.0)	1939 (2.0)	
Unknown	159,833 (97.9)			

T2DM: Type 2 Diabetes Mellitus. * Lifestyle habits were derived from electronic health records and coded by primary health care professionals as binary variables (Yes/No), based on the patient's response to standardized questions during routine primary care encounters. Data were recorded following standardized protocols for clinical episodes and health promotion activities. Absence of information was classified as "unknown".

3.5. Medication-Related Characteristics

Patients with T2DM consumed a higher mean number of medications (10.0 vs. 8.2, $p < 0.001$) and exhibited a higher prevalence of polypharmacy compared with patients without T2DM (59.7% vs. 52.3%, $p < 0.001$). This higher medication burden was driven by drugs from the cardiovascular (ATC group C) and alimentary tract and metabolism (ATC group A) categories, consistent with the underlying cardiometabolic profile of patients with T2DM.

Adherence to pharmacological treatment was lower in the T2DM group (29.8% vs. 40.8%, $p < 0.001$). Concern about adverse drug reactions was slightly more frequent among patients with T2DM, whereas the occurrence of adverse effects at correct doses was similar between groups. Treatment-related complications were slightly more frequent in patients with T2DM, although absolute differences were small (Table 5).

Table 5. Pharmacological characteristics of high-risk patients over 18 years in Madrid (overall and by type 2 diabetes status).

Medication-Related Variables n (%)	Total 163,188 (100)	T2DM 67,746 (41.5)	No T2DM 95,442 (58.5)	*p*-Value
Number of medications consumed				
Mean (SD)	9.0 (3.8)	10.0 (3.8)	8.2 (3.7)	<0.001
Median (IQR)	9.0 (5.0)	10.0 (4.0)	8.0 (5.0)	
Polypharmacy (≥5)	90,322 (55.4)	40,428 (59.7)	49,894 (52.3)	<0.0001
ATC groups *				
Group A	139,935 (85.8)	64,597 (95.4)	75,338 (78.9)	<0.001
Group B	118,554 (72.6)	50,208 (74.1)	68,346 (71.6)	<0.001
Group C	146,572 (89.8)	61,627 (91.0)	84,945 (89.0)	<0.001
Group N	150,339 (92.1)	62,892 (92.8)	87,447 (91.6)	<0.001
Group R	60,105 (36.8)	25,653 (37.9)	34,452 (36.1)	<0.001

Table 5. *Cont.*

Medication-Related Variables n (%)	Total 163,188 (100)	T2DM 67,746 (41.5)	No T2DM 95,442 (58.5)	*p*-Value
Adherence to medication				
Yes	59,125 (36.2)	20,187 (29.8)	38,938 (40.8)	<0.001
No	92,607 (56.8)	45,669 (67.4)	46,938 (49.2)	
Unknown	11,465 (7)			
Medication Concerns and Treatment-Related Problems **				
Concern about medication	50,236 (30.8)	22,047 (32.5)	28,189 (29.5)	<0.001
Adverse effects from medication	15,484 (9.5)	6215 (9.2)	9269 (9.7)	<0.001
Complications of medical treatment	6262 (3.8)	2687 (4.0)	3575 (3.7)	0.022

* ATC groups were assigned according to the active substance included in each patient's baseline pharmacological treatment. ** Medication-related variables were recorded as binary indicators (Yes/No) based on standardized medication review records. T2DM: Type 2 Diabetes Mellitus; SD: Standard Deviation; IQR: Interquartile Range. ATC: Anatomical Therapeutic Chemical.

3.6. Primary Health Care Services Utilization

Overall, the use of primary health care services was extremely high across the high-risk chronic patient population. Patients with T2DM recorded a slightly higher total number of contacts compared with patients without T2DM (mean 24.9 vs. 23.5 visits, $p < 0.001$). When contacts were analyzed by healthcare professional, patients with T2DM had a higher number of nursing visits (mean 9.0 vs. 7.9), whereas patients without T2DM recorded slightly more physician consultations (8.7 vs. 8.3); however, differences were modest. Regarding contact modality, face-to-face and home visits were more frequent among patients with T2DM, while telephone consultations were marginally more common among patients without T2DM. Despite these differences reaching statistical significance, absolute differences were small, indicating broadly similar patterns of primary health care utilization between groups (Table 6).

Table 6. Utilization of Primary Health Care Services.

Contacts with Primary Health Care Services *	Total 163,188 (100)	T2DM 67,746 (41.5)	No T2DM 95,442 (58.5)	*p*-Value
Total contacts				
Mean (SD)	24.1 (18.1)	24.9 (18.6)	23.5 (17.7)	<0.001
Median (IQR)	20.0 (20.0)	21 (19.0)	20.0 (11.0)	
Professional contacted **				
Family Medicine Doctor				
Mean (SD)	11.7 (8.5)	11.4 (8.3)	11.9 (8.7)	<0.001
Median (IQR)	10.0 (10.0)	10.0 (10.0)	10.0 (10.0)	
Primary Health Care Nurse				
Mean (SD)	8.4 (11.0)	9.0 (11.6)	7.9 (10.4)	<0.001
Median (IQR)	5.0 (9)	5.0 (10)	4.0 (8)	
Primary Health Care Pharmacist				
Mean (SD)	1.4 (0.8)	1.4 (0.8)	1.4 (0.8)	0.520
Median (IQR)	1.0 (1.0)	1.0 (1.0)	1.0 (1.0)	
Form of contact **				
Presential				
Mean (SD)	18.8 (15.6)	19.2 (15.7)	18.4 (15.4)	<0.001
Median (IQR)	15.0 (17.0)	15.0 (18.0)	14.0 (17.0)	

Table 6. *Cont.*

Contacts with Primary Health Care Services *	Total 163,188 (100)	T2DM 67,746 (41.5)	No T2DM 95,442 (58.5)	*p*-Value
Phone				
Mean (SD)	12.8 (11.3)	12.7 (11.2)	12.9 (11.5)	0.004
Median (IQR)	10.0 (12.0)	10.0 (12.0)	10.0 (12.0)	
Home visit				
Mean (SD)	7.9 (13.1)	8.3 (13.9)	7.7 (12.6)	0.005
Median (IQR)	4.0 (7.0)	4.0 (7.0)	3.0 (7.0)	

T2DM: Type 2 Diabetes Mellitus; SD: Standard Deviation; IQR: Interquartile Range. * Annual primary health care service utilization was assessed as the total number of contacts recorded during a one-year period (30 April 2021 to 30 April 2022). No recorded contacts were included and classified as zero contacts. ** Utilization is described independently by the contacted healthcare professionals and by the form of contact. "Form of contact" represents an alternative and independent classification rather than a collapsed measure.

3.7. Factors Associated with T2DM

In the multivariate model constructed to identify factors independently associated with the presence of T2DM among high-risk chronic patients, age was positively associated with T2DM (OR 1.016 per year), whereas female sex was associated with a lower likelihood of diabetes (OR 0.660). Regarding functional status, dependency was modestly associated with T2DM (OR 1.078).

With respect to clinical characteristics, patients in the highest quartile of morbidity complexity according to the Adjusted Morbidity Groups index (Q4) were more likely to have T2DM (OR 1.307). Hypertension (OR 1.588), dyslipidemia (OR 1.484), obesity (OR 1.556), ischemic heart disease (OR 1.200), chronic kidney disease (OR 1.188), and anemia (OR 1.389) were positively associated with T2DM. In contrast, depression (OR 0.888), chronic obstructive pulmonary disease (COPD) (OR 0.704), and neoplasia (OR 0.688) were inversely associated with T2DM. Smoking was positively associated with diabetes (OR 1.232), whereas alcohol abuse was associated with a lower likelihood of T2DM (OR 0.838).

In terms of pharmacological variables, polypharmacy was associated with the presence of T2DM (OR 1.323), while higher medication adherence was associated with a lower likelihood of diabetes (OR 0.535). Medication-related concerns showed a modest positive association with T2DM (OR 1.065) (Table 7).

Table 7. Independent factors associated with type 2 diabetes mellitus among high-risk chronic patients.

Variables *	OR	IC 95%	*p*-Value
Age	1.016	1.014–1.017	<0.001
Sex	0.660	0.645–0.676	<0.001
Dependent	1.078	1.048–1.108	<0.001
Highest quartile of Adjusted Morbidity Groups complexity index	1.307	1.274–1.341	<0.001
Hypertension	1.588	1.539–1.638	<0.001
Hyperlipidemia	1.484	1.450–1.519	<0.001
Obesity	1.556	1.521–1.592	<0.001
Ischemic heart disease	1.220	1.171–1.231	<0.001
Chronic kidney disease	1.188	1.157–1.200	<0.001
Anemia	1.389	1.357–1.422	<0.001
Depression	0.888	0.876–0.910	<0.001
COPD	0.704	0.684–0.725	<0.001
Neoplasms	0.688	0.667–0.710	<0.001
Tobacco use	1.232	1.176–1.286	<0.001
Alcohol abuse	0.838	0.797–0.881	<0.001
Concern about medication	1.065	1.038–1.093	<0.001
Adherence to Medication	0.535	0.523–0.547	<0.001
Polypharmacy	1.323	1.283–1.364	<0.001

COPD: Chronic Obstructive Pulmonary Disease. OR: Odd Ratio; IC: Confidence Intervals; Nagelkerke's $R^2 = 0.107$. * Variables come from a multivariable model adjusted for other covariates.

4. Discussion

4.1. Main Findings

This study provides a comprehensive characterization of high-risk chronic patients with and without T2DM in a large primary health care population. T2DM accounted for a substantial proportion of the population and was consistently associated with distinct differences across sociodemographic, functional, clinical, therapeutic, and healthcare utilization domains. Overall, the findings highlight T2DM as a key marker of complexity within an already vulnerable population.

Regarding sociodemographic characteristics, patients with T2DM were slightly older overall, with a higher concentration in the between 66 and 80 age group, and a higher proportion of men. Socioeconomic deprivation levels were comparable between groups; however, a higher prevalence of T2DM was observed among patients in lower-income individual health card categories, suggesting a potential social gradient within this high-risk population (Table 1).

From a functional perspective, most patients remained independent; nevertheless, patients with T2DM showed slightly higher rates of dependency and immobility. This translated into a greater need for informal caregiving, more often provided by adult offspring and partners. Living alone was similarly frequent in both groups, indicating that differences in caregiving needs were more closely related to functional status than household composition. In contrast, the slightly higher use of palliative care among patients without T2DM may reflect differences in underlying disease trajectories, such as advanced oncological or neurodegenerative conditions (Table 2). Taken together, these findings point to an additional functional burden and increased caregiving needs among high-risk patients with T2DM.

Clear differences were also observed in the clinical profile of both groups. Patients with T2DM were more frequently concentrated in the highest quartile of Adjusted Morbidity Groups complexity index, highlighting the close association between diabetes, multimorbidity, and increased healthcare needs. They also presented a higher number of chronic conditions per patient and a predominantly cardiometabolic–renal profile, including hypertension, dyslipidemia, obesity, ischemic heart disease and chronic kidney disease, and anemia. In contrast, patients without T2DM more often exhibited a neuropsychiatric–oncological, and respiratory profile, including depression, COPD, neoplasia, and other non-cardiometabolic conditions (Tables 3 and S2). This clear differentiation of morbidity patterns across groups underscores the role of T2DM as a central driver of cardiometabolic clustering within high-risk populations.

Health-related behaviors showed more modest but still relevant differences. Patients with T2DM had slightly higher tobacco use, while alcohol and substance abuse were less frequently recorded. Even these minor differences in smoking prevalence may have clinically relevant implications in high-risk populations, given the well-established synergistic effect of tobacco use and diabetes on cardiovascular risk and long-term outcomes. Physical activity and adherence to the Mediterranean diet were marginally higher among patients with T2DM; however, engagement in healthy habits behaviors was low registered across the high-risk population (Table 4). Importantly, more than half of lifestyle related variables were not recorded, limiting the interpretability of these findings and highlighting persistent gaps in routine lifestyle documentation in clinical practice.

From a therapeutic perspective, polypharmacy was more frequent among patients with T2DM, consistent with their higher burden of cardiometabolic comorbidities. Despite more intensive pharmacological treatment, these patients showed lower medication adherence and slightly higher concern about medications, reflecting greater treatment awareness and cumulative exposure to long-term pharmacotherapy (Table 5). This pattern illustrates the

tension between treatment intensity and adherence in patients exposed to complex and long-term therapeutic regimens, and highlights adherence as a critical challenge in the management of high-risk diabetic patients.

Healthcare utilization patterns were broadly similar between groups, although patients with T2DM showed slightly higher overall contact rates, particularly with nursing services. This finding is consistent with the significant role of nursing in diabetes care, including monitoring, treatment adjustment, and long-term follow-up. Differences in consultation modalities were small and of limited clinical relevance (Table 6). This pattern reinforces the central position of primary health care, and especially nursing care in the management of high-risk diabetic patients.

Finally, multivariate analysis identified older age, male sex, functional dependency, Adjusted Morbidity Groups complexity in the highest quartile, cardiometabolic comorbidities, polypharmacy, lower medication adherence, and greater concern about medications were independently associated with the presence of T2DM (Table 7).

4.2. Comparison with Other Studies

In this population of high-risk chronic patients, several factors were independently associated with the presence of T2DM, consistent with findings previously reported in the literature.

The positive association between age and T2DM aligns with numerous population-based studies demonstrating a progressive increase in diabetes prevalence with advancing age. This relationship has been linked to age-related metabolic changes, cumulative exposure to cardiometabolic risk factors, and increasing insulin resistance over the life course [20]. Likewise, the lower likelihood of T2DM observed among women is concordant with prior evidence from clinically complex populations, in which men tend to exhibit a higher cardiometabolic burden and a greater prevalence of diagnosed diabetes [21].

Although overall socioeconomic deprivation was similar between groups, patients holding the lower-income health coverage category tended to have a higher prevalence of T2DM. This finding reflects subtle social gradients and is consistent with literature linking lower socioeconomic resources to an increased risk of diabetes [22].

Functional dependency and immobility were more prevalent among patients with T2DM, indicating that high-risk diabetic patients experience greater functional limitations This finding is associated with higher care needs and clinical complexity, in line with evidence linking diabetes to disability and reduced physical functioning reported in other studies [23].

Patients with T2DM showed a higher morbidity burden, with a greater concentration in the highest quartile of clinical complexity, consistent with previous research indicating that diabetes frequently coexists with multiple chronic conditions and increased healthcare needs [24]. The associations observed with hypertension, dyslipidemia, obesity, ischemic heart disease, chronic kidney disease, and anemia reproduce the cardiometabolic continuum widely described in the literature [25,26], confirming that classical cardiometabolic comorbidities remain the main clinical determinants of T2DM. Conversely, inverse associations with depression, COPD, disorder, neoplasia, and alcohol abuse are consistent with studies reporting a lower apparent prevalence of T2DM among patients with severe non-cardiometabolic chronic conditions [27,28]. These findings are likely to be explained by competing mortality, reduced diagnostic intensity, or differences in clinical prioritization, rather than by true protective effects. This clustering of comorbidities in diabetic patients contributes not only to higher disease burden but also to the need for more intensive monitoring and coordinated care. These findings reinforce the notion that T2DM is a vital component of multimorbidity in high-risk populations and underscores the impor-

tance of incorporating complexity-based stratification into clinical decision-making and resource allocation.

Regarding treatment-related variables, the observed associations are also in line with previous studies [29]. Polypharmacy was associated with a higher likelihood of T2DM, reflecting the accumulation of cardiometabolic comorbidities and the need for complex therapeutic regimens in high-risk diabetic patients. In contrast, higher medication adherence was associated with a lower likelihood of T2DM, suggesting that chronic patients without T2DM may maintain better treatment continuity, due to less demanding regimens or a lower daily self-management burden. This pattern could also reflect the cumulative complexity experienced by patients with T2DM, who often manage multiple medications for cardiometabolic comorbidities, increasing the risk of non-adherence. Concern about medication showed a modest positive association with T2DM, reflecting increased treatment awareness among patients with established diabetes [30].

These findings are consistent with previous evidence indicating that therapeutic complexity, multimorbidity, and polypharmacy act as structural barriers to medication adherence in patients with T2DM. Both international and national studies have shown that suboptimal adherence is associated with poorer glycemic control, reduced quality of life, and worse clinical outcomes [29,31]. In this context, clinical guidelines recommend periodic medication review, the identification of potentially inappropriate prescriptions, and the simplification of complex regimens through multidisciplinary approaches [32]. Strengthening structured therapeutic education is also essential, with nursing professionals playing a key role in reinforcing self-care behaviors, improving treatment understanding, and ensuring proactive follow-up, particularly in patients with higher clinical complexity.

4.3. Applicability

From a primary health care perspective, this study provides a detailed characterization of high-risk patients with T2DM compared with high-risk chronic patients without T2DM, highlighting differences in sociodemographic, functional, clinical, treatment-related, and primary health care utilization profiles. Identifying factors independently associated with T2DM may improve risk stratification and help prioritize preventive, diagnostic, and follow-up interventions in complex chronic populations.

The coexistence of classical cardiometabolic comorbidities alongside inverse associations in certain clinical subgroups underscores the importance of comprehensive patient assessment that accounts for multimorbidity and healthcare utilization patterns. The findings highlight the need to strengthen strategies aimed at promoting optimal therapeutic management in primary health care, particularly among patients with T2DM, multimorbidity, and polypharmacy who are classified as high-risk using the Adjusted Morbidity Groups stratification system recorded in electronic health records. Previous small-sample studies have shown that risk stratification tools integrated into electronic health records can enhance targeted interventions, medication management, and primary health care resource allocation [33].

From a public health perspective, these findings have important implications for national-level strategies and interventions. By identifying high-risk patient profiles and factors associated with T2DM, the study supports the design of targeted population health programs, more efficient resource allocation, and the implementation of preventive and management strategies aimed at reducing the burden of T2DM and associated complications. Overall, these findings may inform the development of more personalized management strategies and more efficient resource allocation in primary health care.

4.4. Strengths and Limitations

This study has several important strengths. The large sample size provides high statistical power and enables a comprehensive characterization of sociodemographic, clinical, pharmacological, functional, and healthcare utilization profiles in a real-world primary health care setting. The use of routinely collected electronic health record data ensures systematic and standardized recording of diagnoses, prescriptions, and key patient characteristics, reducing recall bias and enhancing internal validity. In addition, the application of the Adjusted Morbidity Groups risk stratification system allows for a robust assessment of clinical complexity and facilitates interpretation of findings in a population of high-risk chronic patients. The use of a multivariate regression model enabled the identification of factors independently associated with T2DM while adjusting for potential confounders and prioritizing model parsimony and clinical coherence. The model included clinically relevant variables, as well as sociodemographic, functional, pharmacological, and chronic condition variables, alongside the Adjusted Morbidity Groups morbidity complexity index. This model showed moderate explanatory capacity, consistent with the multifactorial nature of T2DM and the influence of determinants not captured in administrative databases.

Among the main limitations, the cross-sectional design precludes causal inference; therefore, all observed relationships should be interpreted as associations rather than direct effects. Several lifestyle-related variables—particularly physical activity, dietary patterns, sleep habits, stress, and risk of sexually transmitted infections—were under-recorded in the electronic primary health care records, reflecting inconsistent documentation in routine practice. Consequently, a high proportion of unknown values was observed for these variables, whereas most other variables were fully reported. Additionally, medication adherence could not be verified in a small proportion of patients. In relation to these, it should be noted that the potential role of unmeasured confounding cannot be ruled out and may have affected some associations.

Given the large sample size, most differences between patients with and without T2DM reached statistical significance; however, the magnitude of these differences was small in some cases and should be interpreted with caution from a clinical perspective.

Finally, the study was conducted within a single regional healthcare system, SERMAS, which may limit generalizability to other settings. Nevertheless, as part of the Spanish National Health System, which provides near-universal healthcare coverage [12], this supports the population-based design and the representativeness of the study.

5. Conclusions

The comparison between high-risk chronic patients with and without T2DM reveals notable differences across multiple clinical and healthcare domains with clear implications for clinical practice and health system planning. Sociodemographically and functionally, patients with T2DM present profiles that may influence care needs, care coordination, and interactions with the healthcare system. The higher burden of limitations observed among diabetic patients can directly affect clinical management and the feasibility of complex therapeutic interventions in primary health care.

Clinically, the high-risk diabetic population is characterized by greater multimorbidity and a predominance of cardiometabolic comorbidities, resulting in increased care complexity and higher rates of polypharmacy. Multivariate analysis confirmed that T2DM is independently associated with classical cardiometabolic risk factors, as well as indicators of clinical complexity and therapeutic management, even after adjusting for sociodemographic and functional characteristics. The slightly higher prevalence of tobacco use observed among patients with T2DM underscores the need to reinforce smoking cessation strategies within primary health care, particularly in high-risk populations. These

differences in tobacco use, together with the elevated cardiovascular risk in this population, highlight the importance of national-level public health actions aimed at reducing tobacco consumption and promoting healthier lifestyle behaviors. Implementing such strategies is essential to mitigate cardiovascular risk and improve long-term outcomes among patients with diabetes.

Differences in primary health care utilization were also observed, with patients with T2DM having more frequent contacts, likely reflecting the need for ongoing clinical monitoring, treatment adjustments, and complication prevention. From a healthcare system perspective, these patterns highlight the central role of primary health care—and especially nursing—in the long-term management of high-risk diabetic patients.

Overall, this study underscores the importance of tailoring primary health care models to the specific profile of high-risk diabetic patients, incorporating integrated strategies that address risk stratification, multimorbidity, and healthcare complexity. This approach may support more efficient resource allocation, individualized interventions, and preventive strategies within primary health care.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/diabetology7030045/s1, Table S1: List of study variables and their measurements; Table S2: Type of chronic disease in high-risk patients over 18 years in Madrid (overall and by type 2 diabetes status).

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Institutional Review Board Statement: This investigation received ethical approval from the Hospital Universitario La Princesa Drug Research Ethics Committee (protocol code 5137; approved on 21 March 2023) and obtained a favorable report from the Local Research Commission of the Primary Health Care Management of the Community of Madrid (protocol code 20230007; approved on 10 March 2023). As this is an observational study based on routinely collected electronic health records, the protocol was not formally published. Every method in this study was performed in accordance with relevant guidelines and regulations.

Informed Consent Statement: The requirement of informed consent from patients was waived, because this study is retrospective and does not contain individual personal information, since the data were obtained from a secondary database with anonymized and dissociated information as established by the current legislation.

Data Availability Statement: Datasets generated and analyzed during the current study are not publicly available due they belong to the Madrid Health Service, but are available from the corresponding author on reasonable request.

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Abbreviations

The following abbreviations are used in this manuscript:

ADHD	Attention Deficit Hyperactivity Disorder
ATC	Anatomical Therapeutic Chemical
BEAMER	BehavioRal and AdherencE Model for improving quality, health outcomes and cost-Effectiveness of healthcaRe
CI	Confidence Intervals.
CNS	Central Nervous System
COPD	Chronic Obstructive Pulmonary Disease
FIBHUNJ	Foundation for Biomedical Research of Hospital Niño Jesús
FIIBAP	Foundation for Biosanitary Research and Innovation in Primary Health Care
HIV	Human Immunodeficiency Virus
ICPC-2	International Classification of Primary Care, Second Edition
IQR	Interquartile Range
ORs	Odds Ratios
PDC	Proportion of Days Covered
SD	Standard Deviation
SERMAS	Madrid Health Service
T2DM	Type 2 Diabetes Mellitus
TSI	Individual Health Card
UCJC	Universidad Camilo José Cela

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