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Original research

The majority of type 2 diabetic patients in Finnish primary care are at very high risk of cardiovascular events: A cross-sectional chart review study (STONE HF)

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ABSTRACT

Aims: To characterize clinical profiles, prevalence of chronic kidney disease (CKD), and treatment patterns in type 2 diabetes (T2D) and heart failure (HF) patients in Finnish primary care.
Methods: A total of 1385 patients (1196 with T2D, 50 with HF, and 139 with T2D and HF) in 60 Finnish primary care centers were recruited to this cross-sectional study. Data on demographic and clinical characteristics, laboratory measurements, and medications were collected retrospectively from medical records. T2D patients were classified according to their risk of cardiovascular (CV) events as very high-risk (62%) and other patients (38%).
Results: Of the T2D patients, 10% (139/1335) had a diagnosis of HF and 42% (457/1090) had stage 3–5 CKD and/or albuminuria based on laboratory measurement. Of the HF patients, 74% (139/189) had T2D and 78% (114/146) had stage 3–5 CKD and/or albuminuria. Metformin was the most frequently used medication in both very high-risk patients (74%) and other patients (86%). SGLT2 inhibitors and/or GLP-1 analogues were used by 37% of very high-risk patients compared to 42% in other patients.
Conclusions: The majority of T2D patients in Finnish primary care are at very high risk of cardiovascular events. However, the implementation of treatments with proven cardioprotective effects in very high-risk patients is currently suboptimal.

1. Introduction

The global prevalence of type 2 diabetes mellitus (T2D) and heart failure (HF) have increased dramatically in recent decades, causing a significant burden on affected individuals and health care systems [1,2]. T2D and HF share many risk factors, and the co-prevalence further worsens adverse outcomes, quality of life (QoL), and costs of care [3–5]. The estimated prevalence of HF in T2D patients varies between 9–28%, with a higher prevalence in T2D patients 60 years and older [4,6]. Accordingly, the prevalence of T2D in HF cohorts has been reported to range from 10% to 47%, being highest in patients hospitalized due to HF [5].

The prevalence of chronic kidney disease (CKD) has increased in recent decades commensurate with an increase in T2D and hypertension, which are the main drivers of CKD [7–9]. It has been estimated that approximately 40% of patients with T2D suffer from

Abbreviations: T2D, Type 2 diabetes mellitus; HF, Heart failure; CKD, Chronic kidney disease; GLP-1, Glucagon-like peptide-1; SGLT-2, Sodium-glucose co-transporter-2; CV, Cardiovascular; DKD, Diabetic kidney disease.

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CKD, and diabetic kidney disease (DKD) is the leading cause of end-stage renal disease globally [9–11]. T2D patients with CKD have a high risk of cardiovascular (CV) events and mortality, and it has been suggested that T2D patients with CKD predominantly account for the increased mortality observed in T2D [12].

Recently updated international treatment guidelines for T2D highlight the assessment of individual risk factors, especially the presence of established atherosclerotic cardiovascular disease (ASCVD), CKD, and HF, in treatment decisions [13,14]. The European Society of Cardiology (ESC) and the European Association for the Study of Diabetes (EASD) categorize patients with diabetes into three categories based on their CV risk [13,14]. Identification of T2D patients at high CV risk has important therapeutic and clinical implications and is critical for improving the outcomes of T2D. Accumulating evidence suggests that sodium-glucose co-transporter-2 (SGLT2) inhibitors and glucagon-like peptide-1 (GLP-1) analogue liraglutide improve CV outcomes and progression of CKD in very high-risk T2D patients [15–17]. Thus, new care guidelines recommend SGLT2 inhibitors and GLP-1 analogues as a preferable treatment, along with metformin for T2D patients with high CV risk [14,18].

Finland has a population of 5.5 million, and T2D affects approximately 400,000 individuals [19]. Together, the prevalence of type 1 diabetes and T2D is approximately 8%, and they account for 15% of direct health care costs. The vast majority of Finnish T2D patients, often with multimorbidity, are treated in primary care centers. Detailed understanding of patient characteristics and current treatment is fundamental for implementing new care guidelines and developing clinical practices in T2D. The aim of this cross-sectional chart review study was to characterize clinical profiles and treatment patterns of T2D and HF patients in primary care centers during 2019–2020 in Finland. Of particular interest was the prevalence of CKD in T2D and HF patients, and the current treatment and proportion of very high-risk T2D patients in Finnish primary care.

2. Methods

2.1. Study design and population

Data were collected retrospectively from primary care medical records throughout Finland (13 of the total 20 hospital districts in mainland Finland covered). Study physicians were recruited through general notifications and direct invitations were sent to 203 physicians. In total, 78 physicians participated in the study as investigators, of whom 60 participated in data collection. Each physician was invited to enroll 20–40 consecutive adult (≥18 years of age) patients (maximum three per day) with T2D and/or HF, who came for a regular visit (index visit) occurring between March 2019 and March 2020. HF was defined as having a history of hospitalization(s) due to HF and/or a diagnosis for HF given either by a cardiologist or primary care physician. For T2D, only patients with a confirmed diagnosis were included. All patients signed informed consent before the data collection. Data were collected into an electronic case report form directly after the index visit. Medication data were based on the medication used prior to the index visit. The final study population included a total of 1385 patients: 1196 were recruited based on T2D, 50 based on HF, and 139 based on both T2D and HF.

2.2. Outcome measures

The following information was collected for each patient: age, gender, height, body weight, smoking status, date of the first T2D/HF diagnosis, comorbidities (dyslipidemia, hypertension, CVDs, diabetic kidney disease/other kidney diseases), time and type (doctor/nurse) of the previous control visit, and glucose-lowering, HF, hypertension and lipid-lowering treatments. The most recent laboratory values available within the last 12 months were collected from medical records: glycated hemoglobin (HbA1c), fasting plasma glucose (FPG), estimated glomerular filtration rate (eGFR), serum creatinine, urine albumin, and urine albumin to creatinine ratio (U-Alb/crea ratio). Body mass index (BMI) was calculated during the index visit based on height and weight measurements. Information on the laser treatment for retinopathy and history of severe hypoglycemia within the last year were based on T2D patients' own reporting during the index visit. For HF patients, data on echocardiography, type of HF, and the New York Heart Association (NYHA) class were collected from the medical records.

The estimated glomerular filtration rate (eGFR) was calculated using the CKD-EPI formula [20]. The CKD stage was categorized based on the classification system established by the National Kidney Foundation Kidney Disease Outcomes Quality Initiative [21]. The presence of increased albuminuria was defined by U-alb/crea ratio (≥2.5 mg/mmol in males and ≥3.5 mg/mmol in females) or by U-alb (≥20 μg/min) if U-alb/crea ratio was not determined. Notable CKD was defined as stage 3–5 CKD (eGFR <60 ml/min/1.73 m^2) and/or increased albuminuria.

2.3. Study groups and analysis

The main study groups were patients with T2D and patients with HF. Subgroups consisted of patients defined as T2D+HF+, T2D+HF−, and T2D−HF+. T2D patients were further classified into two risk categories (very high-risk patients vs. other patients with moderate and high risk) according to the ESC/EASD guidelines [13]. Very high-risk patients included patients with diagnosed CVD (coronary artery disease, coronary artery bypass grafting, percutaneous transluminal angioplasty, peripheral artery disease, stroke; or transient ischemic attack, myocardial infarction, HF), and/or stage 3–5 CKD (eGFR <60 ml/min/1.73 m^2) and/or increased albuminuria. Only patients who had all the necessary information available were included in the analyses. All analyses were descriptive. Results for categorical variables are presented as the number (n) and proportion (%) of patients per eligible patients and prevalence percentages (%). Continuous variables are presented as median and the first (Q_1) and the third (Q_3) quartile. In addition, 95% confidence intervals are presented for the prevalence of CKD.

2.4. Ethics committee approval

The Ethics Committee of the Hospital District of Southwest Finland evaluated the study protocol and granted ethical approval for the study. In addition, each participating investigator received a permit for data collection from the local social and health care joint authority or from the senior physician.

3. Results

3.1. Patient characteristics

Of the 1385 patients included in the study population, a total of 1335 had T2D (44% female) and a total of 189 had HF (45% female), and 139 patients had both T2D and HF (Fig. 1, Table 1). The median age was 70.3 years in patients who had T2D and 75.4 years in patients with HF. Altogether, 10% (139/1335) of T2D patients also had HF and 74% (139/189) of HF patients also had T2D. A majority of T2D (56%) and HF (57%) patients had obesity (BMI ≥ 30 kg/m^2). The proportion of current smokers was 12% in T2D patients and 9% in HF patients. Dyslipidemia (T2D, 85%; HF, 81%) and hypertension (T2D, 84%; HF, 86%) were common comorbidities among patients. CVD

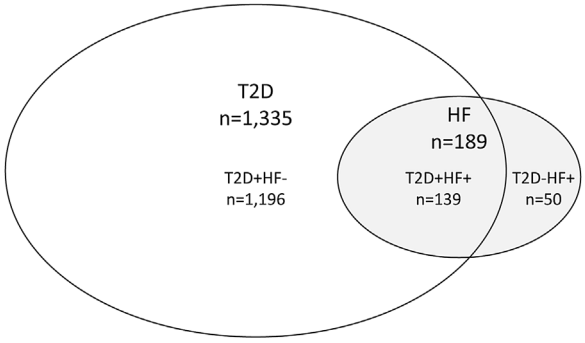

Fig. 1. Distribution (Venn diagram) of study patients (number of patients) into type 2 diabetes (T2D) and heart failure (HF).

Table 1
Clinical characteristics of patients with type 2 diabetes (T2D) and heart failure (HF).

	T2D[a] (n = 1335)		HF (n = 189)	
	Median (Q_1–Q_3)		Median (Q_1–Q_3)	
Age (years)	70.3 (62.9–76.2)		75.4 (70.9–81.8)	
BMI (kg/m^2)	30.8 (27.5–35.1)		30.8 (27.5–34.6)	
	n	%	n	%
Sex: Female	589	44.1	85	45.0
BMI: ≥30 kg/m^2	720	56.2	104	57.1
Smoking status: never	850	64.2	130	69.9
Current smoker	153	11.6	16	8.6
Former smoker	321	24.2	40	21.5
Comorbidities	n	%	n	%
Dyslipidemia	1138	85.2	153	81.0
Hypertension	1120	83.9	162	85.7
Cardiovascular diseases	558	41.8	165	87.3
Stroke or transient ischemic attack	157	11.8	33	17.5
Atrial fibrillation	230	17.2	117	61.9
Valvular heart disease	128	9.6	73	38.6
Peripheral artery disease	96	7.2	24	12.7
Coronary artery disease (PTA/-CABG)	320	24.0	96	50.8
Myocardial infarction	135	10.1	46	24.3

[a] Abbreviations: BMI, body mass index; CABG, coronary artery bypass grafting; HF, heart failure; PTA, percutaneous transluminal angioplasty; T2D, type 2 diabetes; Q_1, first quartile; Q_3, third quartile.

other than HF was present in 42% and 87% of T2D and HF patients, respectively.

3.2. The prevalence of CKD in patients with T2D and HF

The majority (>98%) of T2D and HF patients had eGFR information available, whereas information on albuminuria was missing in 24% of T2D and 44% of HF patients (Table 2). Stage 2 CKD (eGFR of 60–89 ml/min/1.73 m^2) and stage 3 CKD (eGFR of 30–59 ml/min/1.73 m^2) were the most common CKD categories in T2D (50%) and HF (44%) patients, respectively. The prevalence of stages 1–5 CKD was 78% (954/1220) in T2D patients and 95% (173/182) in HF patients. Of patients who had laboratory test results of both eGFR and albuminuria available, notable CKD (stage 3–5 CKD and/or the presence of increased albuminuria) was present in 42% (457/1090) of T2D patients and in 78% (114/146) of HF patients. Of the patients who did not have a previous diagnosis of DKD, 31% were identified to have DKD based on laboratory measurements. The prevalences of notable CKD in the subgroups T2D+HF+, T2D+HF−, and T2D−HF+ were 76% (92/121), 38% (365/969), and 88% (22/25), respectively.

3.3. Clinical characteristics and treatment of T2D patients

In T2D patients, the median duration of the disease was 10.9 years (Table 3a). The median time since the last follow-up visit was 6.0 months and 75% of T2D patients had a previous visit within 11.4 months. Lipid-lowering treatment was used by 73% and angiotensin-converting enzyme inhibitors (ACEIs) or angiotensin II receptor blockers (ARBs) by 77% of T2D patients (Table 3b).

The median HbA1c was 50.0 mmol/mol (6.7%) and 57% of T2D patients had HbA1c below the target level of 53.0 mmol/mol (7.0%). Metformin was the most commonly used glucose-lowering treatment, used by 79% of T2D patients who had a glucose-lowering treatment. Dipeptidyl peptidase-4 (DPP-4) inhibitors were used by 33%, SGLT2 inhibitors by 30%, and GLP-1 analogue by 14% of the T2D patients on glucose-lowering treatment. Insulin was used by 39% of T2D patients as a combination or monotherapy. The majority of patients (65%) used more than one glucose-lowering treatment.

3.4. Clinical characteristics and treatment of HF patients

The median duration of HF was 4.3 years (Table 3a). The median time since the last follow-up visit was 6.5 months and 75% of HF patients had a previous visit within 12.3 months. Most of the HF patients (89%) had echocardiography performed. Diastolic HF (heart failure with preserved ejection fraction, HFpEF) was slightly more common (39%) than systolic (heart failure with reduced ejection fraction, HFrEF; 34%), while the type was not known for 26% of patients. Based on the NYHA classification, most HF patients (67%) had no/mild symptoms (NYHA I–II), whereas 27% had marked or severe limitations due to HF symptoms (NYHA III–IV). Altogether, 31% of the HF patients had required hospitalization during the past year.

Lipid-lowering treatment was used by 76% and both ACEis/ARBs and beta-blockers by 84% of HF patients (Table 3b). Diuretics were used by 78%, and other medications for HF by fewer than 20%. Calcium channel blockers (with no symptomatic or survival benefit in HF) were used by 32% of the patients.

3.5. Clinical characteristics and treatment of very high-risk T2D patients

Altogether, 62% of T2D patients were classified as having a very high risk of CV events (Table 4). The median disease duration in very high-risk T2D patients was 12.0 years compared to 9.8 years in other T2D patients. The median eGFR values were 67.4 ml/min/1.73 m^2 (95% CI, 52.1–87.1) and 88.3 ml/min/1.73 m^2 (95% CI, 76.6–96.9) in very high-risk and other T2D patients, respectively.

The patients at very high risk more commonly used a DPP-4 inhibitor (37% vs. 31%) and insulin (as combination or monotherapy; 46% vs. 32%) than other T2D patients. Conversely, metformin (71% vs. 86%) and SGLT2 inhibitors and/or GLP-1 analogues (37% vs. 42%) were less frequently used by very high-risk patients compared to other patients.

4. Discussion

This national, cross-sectional chart review study assessed clinical profiles and treatment patterns of Finnish primary care T2D and HF patients during 2019–2020, a time period shortly after the update of international treatment guidelines. The study indicated that more than 40% of the primary care T2D patients had notable CKD, 10% had HF, and 62% of T2D patients were classified as having a very high-risk of CV events. Overall, the care of the patients followed well both the national and international guidelines. However, despite the proven cardioprotective effects of SGLT2 inhibitors

Table 2
The prevalence of chronic kidney disease (CKD) stages, notable CKD, and CKD-related missing information in patients with type 2 diabetes (T2D) and with heart failure (HF), as well as in subgroups of patients with T2D+HF+, T2D+HF−, and T2D−HF+.

							T2D +/− and HF +/− subgroups					
	All patients (n = 1385)		T2D (n = 1335)		HF (n = 189)		A. T2D+HF+ (n = 139)		B. T2D+HF− (n = 1196)		C. T2D−HF+ (n = 50)	
	n	%	n	%	n	%	n	%	n	%	n	%
CKD stage												
0 (eGFR ≥90 ml/min/1.73 m^2)	266	21.0	266	21.8	9	4.9	9	6.7	257	23.7	0	0.0
1 (eGFR ≥90 +albuminuria)	56	4.4	55	4.5	4	2.2	3	2.2	52	4.8	1	2.1
2 (eGFR 60–89)	633	50.0	607	49.8	76	41.8	50	37.0	557	51.3	26	55.3
3 (eGFR 30–59)	290	22.9	273	22.4	80	44.0	63	46.7	210	19.4	17	36.2
4 (eGFR 15–29)	18	1.4	16	1.3	10	5.5	8	5.9	8	0.7	2	4.3
5 (eGFR <15, ESRD)	4	0.3	3	0.2	3	1.6	2	1.5	1	0.1	1	2.1
Notable CKD[a] (increased albuminuria and/or eGFR<60 ml/min/1.73 m^2)	479/1115	43.0	457/1090	41.9	114/146	78.1	92/121	76.0	365/969	37.7	22/25	88.0
Prevalence, % (95% CI)	43.0 (40.1–45.9)		41.9 (39.0–44.9)		78.1 (71.4–84.8)		76.0 (68.4–83.6)		37.7 (34.6–40.7)		88.0 (68.8–97.5)	
Information on eGFR missing	22	1.6	20	1.5	3	1.6	1	0.7	19	1.6	2	4.0
Information on albuminuria missing	356	25.7	318	23.8	84	44.4	46	33.1	272	22.7	38	76.0
CKD stage missing (eGFR missing or albuminuria missing in patients with eGFR ≥90 ml/min/1.73 m^2)	118/1385	8.5	115/1335	8.6	7/189	3.7	4/139	2.9	111/1196	9.3	3/50	6.0

Abbreviations: CKD, chronic kidney disease; eGFR, estimated glomerular filtration rate; CKD-EPI, Chronic Kidney Disease Epidemiology Collaboration; ESRD, end-stage renal disease; HF, heart failure; T2D, type 2 diabetes.
[a] n1/n2 = number of patients with the condition/number of patients among whom the condition can be evaluated.

and GLP-1 analogues, their use was still suboptimal especially in very high-risk T2D patients.

The management of T2D and the evaluation of treatment outcomes have long been based on controlling HbA1c values, hypertension, and dyslipidemia. The recently updated international guidelines highlight the assessment of individual risk as a key element in guiding the clinical and therapeutic decisions in T2D [13,14]. However, several reports indicate that HF and CKD, which are the main risk factors for CV outcomes, are largely underdiagnosed [6,7]. In this study, only 10% of Finnish primary care T2D patients had a diagnosis of HF, compared to the prevalence of 20% previously reported from Finland [3]. Similar prevalences for HF in T2D patients have been reported in international studies (ranging from 9 to 22%), with an even higher prevalence in patients ≥60 years or older [4,6]. Notably, most of the HF hospitalizations in T2D patients have been reported in patients with no prior diagnosis of HF [5]. Together with the fact that the diagnosis of HF is often challenging and requires special expertise, a large proportion of HF cases are still likely to remain undiagnosed [6]. Thus, the actual prevalence of HF in T2D patients treated in Finnish primary care may be significantly higher than the 10% reported in this study.

A previous Finnish study indicated that 35% of T2D patients had notable CKD [7]. In this study, CKD was even more prevalent: 42% of T2D patients had notable CKD. These results are in line with the global and US prevalence estimates of comorbid CKD in T2D (40%), whereas a recent German study indicated higher prevalence (50%) [8,9,22]. Remarkably, only 20% of the T2D patients in this study had been previously diagnosed with DKD. Of the patients who did not have a previous diagnosis of DKD, 31% were identified to have DKD based on laboratory measurements, highlighting the importance of annual screening of eGFR and albuminuria. The monitoring of eGFR was frequent and nearly all (>98%) T2D patients had eGFR values available from the past year. By contrast, albuminuria measurement was missing in 24% of T2D patients, even though a routine assessment of albuminuria is recommended to be carried out annually to identify high CV risk patients [18]. This finding is in line with the previous Finnish study, which indicated that CKD is often undiagnosed in T2D patients [7].

Based on established ASCVD, HF, and diagnosis of CKD in laboratory measurements, this study indicated that 62% of T2D patients treated in the Finnish primary care centers were classified as having a very high risk of CV events. In comparison, a recent large cross-sectional study on the Mediterranean population (n = 373,185) indicated that half of the patients in the primary care register were at very high-risk of CV events [23]. Interestingly, the medication choices in T2D patients did not clearly reflect the CV risk category. Metformin, the recommended first-line treatment for all patients, was used by 74% in the very high-risk group and 86% in other T2D patients. Strikingly, the use of SGLT2 inhibitors and GLP-1 analogue was less frequent in very high-risk patients (37%) compared to other T2D patients (42%). Conversely, the use of DPP-4 inhibitor was more frequent in very high-risk patients (37%) than other patients (31%), although no positive cardioprotective effect has been shown for this medication group in very high-risk patients [24–27]. Insulin was used by almost half (46%) of the very high-risk patients, which may reflect more progressive disease status or suboptimal treatment response with other medications.

Paradoxically, the summary of product characteristics (SPC), at the time of the study, limited the use of SGLT2 inhibitors for patients with eGFR ≥45–60 ml/min/1.73 m^2 [18]. Although these limits were based on efficacy and not safety, and more recent data also indicate that patients with eGFR 25–30 ml/min/1.73 m^2 would benefit from the treatment, SGLT2 inhibitors are rarely used in patients with low eGFR [28–30]. Notably, this study showed that 85% of very high-risk patients had eGFR ≥45 ml/min/1.73 m^2 with a median eGFR of 67 ml/min/1.73 m^2. This suggests that the low eGFR levels do not fully explain the low use of SGLT2 inhibitors in very high-risk patients.

Table 3
The clinical characteristics (a) and treatment (b) of patients with type 2 diabetes (T2D) (n = 1335) and HF (n = 189). The characteristics for each variable are presented for patients who had the information available (the number of reported patients may vary by row).

a)

T2D (n = 1335)			HF (n = 189)		
	n	Median (Q_1–Q_3)		n	Median (Q1–Q3)
Duration of T2D disease (years)	1323	10.9 (5.6–17.0)	Duration of HF disease (years)	177	4.3 (1.3–8.2)
HbA1c (mmol/mol)	1306	50.0 (44.0–59.0)			
HbA1c (%)		6.7 (6.2–7.5)			
FPG (mmol/l)	1014	7.4 (6.6–8.6)			
Time since last follow-up visit (months)	1255	6.0 (2.5–11.4)	Time since last follow-up visit (months)	137	6.5 (3.2–12.3)
	n	%		n	%
Last control visit made by (profession)			Last control visit made by (profession)		
Doctor	731	56.1	Doctor	144	97.3
Nurse	568	43.6	Nurse	3	2.0
Not known	4	0.3	Not known	1	0.7
History of severe hypoglycemia within the last year	4	0.3	HF diagnosed by a specialist	162	85.7
Retinopathy laser-treated	54	4.0	Echocardiography performed		
HbA1c			No	14	7.4
<53 mmol/mol	741	56.7	Yes	168	88.9
≥53 mmol/mol	565	43.3	Not Known	7	3.7
			NYHA class		
			I–II	127	67.2
			III–IV	51	27.0
			Unknown	11	5.8
			Number of hospitalizations during the past year		
			0	130	68.8
			1	38	20.1
			2	13	6.9
			3–9	8	4.2

b)

T2D (n = 1335)			HF (n = 189)		
Medications	n	%	Medications	n	%
Lipid-lowering treatments (statin/other)	981	73.5	Lipid-lowering treatments (statin/other)	143	75.7
ACE-inhibitor or ARB	1031	77.2	ACE-inhibitor or ARB	158	83.6
Glucose-lowering treatment	1270	95.1			
Medications among all patients on treatment:			HF treatment among all patients:		
Metformin	1006	79.2	ACE-inhibitor/ARB	158	83.6
SGLT2 inhibitor	387	30.5	Beta-blocker	159	84.1
GLP-1 analogue	181	14.3	ACE-inhibitor/ARB + beta blocker	133	70.4
DPP-4 inhibitor	425	33.5	Spironolactone	37	19.6
Thiazolidinedione	22	1.7	Calcium channel blocker	60	31.7
Sulfonylurea	14	1.1	ARNI (sacubitril/valsartan)	3	1.6
Glinides	4	0.3	Diuretics	148	78.3
Insulin combination therapy	416	32.8	Digoxin	26	13.8
Insulin monotherapy	78	6.1			
Multiple daily injections	205	16.1			

Abbreviations: ACE, angiotensin-converting enzyme; ARB, angiotensin receptor blocker; DPP-4, dipeptidyl peptidase-4; GLP-1, glucagon-like peptide-1; HbA1c, Hemoglobin A1c; FPG fasting glucose; SGLT2, sodium-glucose co-transporter-2; T2D, type 2 diabetes; Q_1, first quartile; Q_3, third quartile.

As only 60 of the 203 invited clinicians participated in study data collection, there may be a bias towards clinicians and centers that are particularly active in T2D treatment. Additional bias may be caused by the selection of patients, who are actively diagnosed and followed-up in the study population. This seems to indicate that the true prevalence of CKD and HF in T2D patients may be even higher. According to the original study protocol, the study was planned to enroll HF patients only if they had a diagnosis confirmed by a cardiologist and/or at least one hospitalization due to HF. However, due to the slow recruitment rate, inclusion criteria were amended to include all patients with HF diagnosis. Consequently, 86% of all HF patients had a diagnosis confirmed by a cardiologist. It should also be noted that the new care recommendations by EASD/ADA and ESC/EASD were updated in 2018 and 2019, respectively, and Finnish care guidelines for T2D in 2020 [13,14,19]. Thus, their implementation had just started when the data was collected, and the impact on this study population is likely modest.

In conclusion, this study showed that T2D patients treated in Finnish primary care often have multiple comorbidities and are at very high risk for CV outcomes. Overall, the treatment of hyperglycemia, hypertension, and dyslipidemia is of high quality. However, the recent paradigm shift in T2D treatment, which highlights the importance of individual risk assessment in treatment decisions, is yet to be fully implemented. Particular attention should be paid to the identification of very high-risk patients, which form the major proportion of T2D patients treated in primary care. Currently, medications with positive CV and renal effects are used suboptimally in T2D patients who would benefit from them most. Annual screening of eGFR and albuminuria and systematic diagnosis of HF with a consulting cardiologist are required to gain a holistic picture of the patient's status. To optimize treatment outcomes, education on latest guidelines as well as sufficient time and resources should be provided to primary care physicians. Further studies are necessary to characterize different T2D patient populations and their treatment patterns in more detail and to reach

Table 4
Clinical characteristics and treatment of very high-risk type 2 diabetes (T2D) patients vs. T2D patients with moderate to high risk. The characteristics for each variable are presented for patients who had the information available (the number of reported patients may vary by row).

	Patients at very high risk[a] (n = 729)		Patients at moderate to high risk[b] (n = 456)	
	n	Median (Q_1–Q_3)	n	Median (Q_1–Q_3)
Duration of T2D disease (years)	723	12.0 (6.9–18.7)	450	9.8 (4.8–15.0).
Age (years)	729	73.4 (66.8–79.4)	456	67.3 (59.2–72.5)
BMI (kg/m^2)	706	30.7 (27.5–34.6)	434	30.8 (27.2–36.2)
eGFR (ml/min/1.73 m^2)	721	67.4 (52.1–87.1)	456	88.3 (76.6–96.9)
Time since the last follow-up visit (months)	686	6.0 (2.5–11.2)	431	6.0 (2.4–11.6)
	n	%	n	%
Glucose-lowering treatment	694	95.2	441	96.7
Glucose-lowering treatment among all patients on treatment				
Metformin	514	74.1	381	86.4
SGLT2 inhibitor and/or GLP-1 analogue	253	36.5	187	42.4
SGLT2 inhibitor	192	27.7	162	36.7
GLP-1 analogue	99	14.3	70	15.9
DPP-4 inhibitor	253	36.5	135	30.6
Insulin	319	46.0	142	32.2
Insulin monotherapy	59	8.5	13	2.9
Insulin combination therapy	260	37.5	129	29.3

Abbreviations: BMI, body mass index; DPP-4, dipeptidyl peptidase-4; GFR, glomerular filtration rate; GLP-1, glucagon-like peptide-1; SGLT2, sodium-glucose co-transporter-2; T2D, type 2 diabetes; Q_1, first quartile; Q_3, third quartile.

[a] Very high risk: diagnosed cardiovascular disease (coronary artery disease, coronary artery bypass grafting, percutaneous transluminal angioplasty); peripheral artery disease, stroke or transient ischemic attack; myocardial infarction, HF); and/or diabetes with notable CKD (increased albuminuria and/or eGFR <60 ml/min/1.73 m^2).

[b] Other than very high risk, as defined. For 142 patients the risk group could not be assessed.

the aim of early patient identification and cost-effective care in the future.

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Conflicts of interest

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