https://doi.org/10.46389/rjd-2026-2181
www.rjdnmd.org

Rom J Diabetes Nutr Metab Dis
2026; volume 33, issue 1, pages 34–44

Original Article

Lifestyle-related cardiometabolic targets in romanian patients with type 2 diabetes: a cross-sectional analysis

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Received: 10 March 2026 / Accepted: 25 March 2026

Abstract

Patients with type 2 diabetes (T2D) face an increased risk of cardiovascular disease (CVD), with risk factor burden, comorbidities, and poor disease control significantly influencing cardiovascular (CV) risk. A strategy that focuses on the simultaneous control of multiple cardiometabolic and lifestyle-related factors has demonstrated benefits in reducing adverse CV outcomes in this population. This study aims to assess the simultaneous attainment of lifestyle-related and cardiometabolic targets in a real-world cohort of adult patients with T2D from Romania. In this cross-sectional analysis, we evaluated the simultaneous attainment of lifestyle-related and cardiometabolic targets in 174 patients with T2D by using the 2023 ESC Guidelines as a reference for current best-practice recommendations. Simultaneous control of both lifestyle-related targets, namely non-smoking status and normal weight, was observed in only 12 patients (6.9%). Strict extended multifactorial control, defined as attainment of at least 4 of the 6 assessed targets, decreased significantly across higher risk categories (57.1% in the moderate-risk group, 28.0% in the high-risk group, 16.2% in the very-high-risk group, p=0.015). Smoking status was strongly associated with the probability of achieving simultaneous risk factor control, with none of the current smokers achieving four or more of the six targets, whereas 34 nonsmokers (27.9%) did so (p<0.001). Although strict extended control (≥4/6 targets) was numerically more frequent in normal-weight patients than in those with obesity (35.0% *vs.* 16.5%), this difference did not reach statistical significance in the unadjusted categorical comparison (p=0.152). Simultaneous attainment of lifestyle-related cardiometabolic targets was low in patients with T2D. A multidisciplinary approach emphasizing lifestyle changes and optimal risk factor management is urgently needed in these patients.

Keywords: type 2 diabetes, cardiovascular risk, cardiometabolic control, risk factor targets

Abbreviations: ASCVD – atherosclerotic cardiovascular disease; BMI – body mass index; BP – blood pressure; CV – cardiovascular; CVD – cardiovascular disease; ESC – European Society of Cardiology; GLP-1 RAs – glucagon-like peptide-1 receptor agonists; HbA1c – glycated hemoglobin; HDL-C – high-density lipoprotein cholesterol; LDL-C – low-density lipoprotein cholesterol; T2D – type 2 diabetes; TG – triglycerides; TOD – target organ damage; WHO – World Health Organization.

Introduction

Type 2 diabetes (T2D) is associated with increased cardiovascular (CV) risk, and high morbidity and mortality rates once cardiovascular diseases (CVDs) develop [1]. This risk is further augmented by the presence of risk factors, associated diabetes-related complications, socio-demographic factors, longer disease duration and poor disease control [2], leading to a significant variability in CV risk distribution in this patient population [3]. Consequently, the European Society of Cardiology (ESC) has refined risk stratification in dedicated medical guidelines to patients with diabetes, with several updates in the upcoming editions [4–6]. A thorough risk assessment and optimal control of modifiable risk factors, along with lifestyle optimization strategies, are strongly recommended [6]. Current recommendations for managing patients with T2D focus on a patient-centered approach, while placing an emphasis on a comprehensive management strategy for multifactorial CV risk factors control instead of solely achieving control of singular targets in patients both with and without CVD, and implementation of multidimensional strategies including lifestyle optimization and use of cardioprotective therapies with proven benefits [6, 7]. However, simultaneous attainment of lifestyle-related and cardiometabolic targets remains low, with differences observed regarding the risk evaluation methods utilized, the risk factor targets endorsed, and the populations studied [8–11]. Irrespective of these discrepancies, achieving concomitant control of multiple risk factors proves beneficial in patients with T2D, particularly in individuals at an increased risk of experiencing adverse CV outcomes [12, 13].

Our study aimed to assess the simultaneous attainment of lifestyle-related and cardiometabolic targets in a real-world cohort of adult patients with T2D from Romania and to explore the impact of lifestyle-related factors, such as smoking and body weight (based on BMI clusters), on the attainment of traditional cardiometabolic risk factor targets.

Material and methods

Study design and population

This single-center, cross-sectional analysis included 174 Romanian adult patients aged 40–69 years with T2D retrospectively enrolled from a specialized Diabetes Clinic. Both inpatients and outpatients were included in the present study. CV risk was assessed using the latest 2023 ESC Guidelines recommendations and patients were clustered into CV risk categories (moderate, high, very high) based either on their SCORE2-Diabetes value or the presence of guideline-defined criteria for ASCVD and/or severe target organ damage (TOD). Composite control of several modifiable cardiometabolic (HbA1c, LDL-c, triglycerides, BP) and lifestyle-related targets (nonsmoking status, normal BMI) was analyzed across CV risk categories. The study was conducted in accordance with the Declaration of Helsinki and the protocol was approved prior to data collection by the Local Ethics Committee for Scientific Research of Pius Brînzeu Emergency Hospital Timisoara (approval number 418/1 November 2023).

Data collection

All relevant information required to perform the analysis was extracted from available medical records and/or institutional electronic database, in accordance with applicable ethical regulations and with the hospital's policy. Data analysis was performed in an anonymized format. All variables required to perform the study were collected from available medical records and included demographic and anthropometric data (patients' sex, age, weight, height, BMI), clinical and behavioral information (smoking status, diabetes duration, BP values, history of ASCVD, documented diabetes-related complications such as neuropathy, retinopathy, and renal disease and laboratory parameters (total cholesterol, LDL-c, HDL-c, triglycerides, HbA1c, estimated glomerular filtration rate, urinary albumin-to-creatinine ratio).

Cardiometabolic risk factors and lifestyle-related targets definition

The following cardiometabolic risk factors were assessed: lipid profile (LDL-c and triglycerides), glycemic profile (HbA1c), and BP. Additional lifestyle-related factors were also evaluated, such as body weight (clustered based on BMI values) and smoking status. Targets were defined accordingly:

- LDL-c target was determined based on ESC CV risk category: <55 mg/dl (very high risk), <70 mg/dl (high risk), <100 mg/dl (moderate risk);
- Triglycerides (TG) <150 mg/dl
- BP <130 mmHg systolic and <80 mmHg diastolic;
- HbA1c <7%;
- BMI categories were defined according to the World Health Organization (WHO) criteria:

normal weight (BMI <25 kg/m²), overweight (BMI 25–29.9 kg/m²), and obesity (BMI >30 kg/m²);
- Smoking status (yes/no).

Statistical analysis

Data collection was performed using MedCalc Statistical Software version 23.0.8 (MedCalc Software Ltd, Ostend, Belgium), while for data analysis, both MedCalc Statistical Software and Python with the stats model package were used.

Results were presented as mean±standard deviation for numerical variables with a normal distribution, absolute and relative frequencies for data stored in categorical variables, and median and interquartile range for ordinal and continuous variables with non-parametric distribution. For continuous variables, normality was assessed using the Shapiro-Wilk test. Distributions were considered non-Gaussian if the Shapiro-Wilk test had a p-value <0.05.

To evaluate the significance of differences among or between groups, the following statistical tests were used: for variables with normal distribution, the unpaired Student's t-test and ANOVA; for non-Gaussian variables, the Kruskal-Wallis and Wilcoxon rank-sum tests; for categorical variables, the chi-square or Fisher's exact test.

To analyze factors associated with multifactorial CV risk factor control, a multivariable logistic regression model was fitted. The dependent variable was achievement of at least 3 of 5 predefined targets for HbA1c, TG, LDL-C, BMI <25 kg/m² and BP (yes/no). Independent variables were CV risk category (very high, high), age (years), sex (male *vs.* female), and diabetes duration (years). Results were reported as adjusted odds ratios (ORs) with 95% confidence intervals (CIs). All variables were included simultaneously into the model, and a two-sided p-value <0.05 was considered the threshold for statistical significance.

Results

Study population and lifestyle-related profile

A total of 174 adults with T2D were included. Median age was 61.0 [53–65] years and median diabetes duration was 7.0 [2–14] years. Mean BMI was 31.3±5.7 kg/m², mean waist circumference was 105.6±15.4 cm, and overall, only 20 patients (11.5%) had normal weight, while 50 (28.7%) were overweight, and 103 (59.2%) had obesity. 122 (70.1%) participants were non-smokers. Lifestyle-related baseline characteristics distribution did not differ materially between risk strata (Table 1).

Achievement of cardiometabolic and lifestyle targets by CV risk category

Simultaneous attainment of both lifestyle-related targets, namely non-smoking status and normal weight, was observed in only 12 patients (6.9%). Strict extended multifactorial control, defined as attainment of at least 4 of the 6 assessed targets, decreased significantly across higher risk categories, from 57.1% in the moderate-risk group and 28.0% in the high-risk group to 16.2% in the very-high-risk group (p=0.015) (Table 2).

Composite CV risk factor control

When considering two risk factors simultaneously, 16.7% of patients reached the target for HbA1c and BP, 10.9% for LDL-c and BP, while only 5.7% had optimal control of both HbA1c and LDL-c. Only 2.3% of patients attained composite control of HbA1c, LDL-c and BP. The distribution of composite modifiable cardiovascular risk factor targets is presented in Figure 1.

The distribution of multifactorial control was different across cardiovascular risk categories. In the very-high-risk group, 9.9% of patients had no target at goal, 33.1% had one, 35.9% had two, 18.3% had three and

Table 1: Lifestyle-related baseline characteristics according to ESC 2023 CV risk category.

Variable	Overall	Moderate (4.0%)	High (14.4%)	Very high (81.4%)	P-value
Non-smoker	122 (70.1%)	7 (100.0%)	19 (76.0%)	96 (67.6%)	0.148
Normal weight (BMI <25 kg/m²)	20 (11.5%)	1 (14.3%)	4 (16.0%)	15 (10.6%)	0.714
Overweight (BMI 25.0–29.9 kg/m²)	50 (28.7%)	2 (28.6%)	8 (32.0%)	40 (28.2%)	0.927
Obesity (BMI ≥30 kg/m²)	103 (59.2%)	4 (57.1%)	13 (52.0%)	86 (60.6%)	0.720

Note: Continuous variables are presented as median [interquartile range] or mean±standard deviation, as appropriate. Categorical variables are presented as n (%).

https://doi.org/10.46389/rjd-2026-2181

Table 2: Achievement of cardiometabolic and lifestyle-related targets, overall and by CV risk category.

Target	Overall	Moderate	High	Very high	P-value
Non-smoking status	122 (70.1%)	7 (100.0%)	19 (76.0%)	96 (67.6%)	0.148
Normal weight (BMI <25 kg/m²)	20 (11.5%)	1 (14.3%)	4 (16.0%)	15 (10.6%)	0.714
Both non-smoking and normal weight	12 (6.9%)	1 (14.3%)	2 (8.0%)	9 (6.3%)	0.701
Strict extended control (≥4 of 6 targets)	34 (19.5%)	4 (57.1%)	7 (28.0%)	23 (16.2%)	0.015
Very strict extended control (≥5 of 6 targets)	7 (4.0%)	0 (0.0%)	3 (12.0%)	4 (2.8%)	0.084

Note: Strict extended control was defined as achievement of at least 4 of the following 6 targets: HbA1c, LDL-c, triglycerides, blood pressure, non-smoking status, and normal weight.

2.8% had four targets at goal. In the high-risk group, the corresponding proportions were 12.0%, 24.0%, 24.0%, 28.0% and 12.0%, while in the moderate-risk group more than half of patients (57.1%) had three controlled targets, although numbers were small (n=7).

The proportion of patients with ≥3 of 5 targets controlled decreased with increasing cardiovascular risk category: 57.1% in moderate-risk, 40.0% in high-risk and 21.1% in very-high-risk patients (p=0.019; Table 3). These findings indicate that multifactorial control is particularly suboptimal in the very-high-risk subgroup.

Factors associated with composite risk factor control in T2D

In an exploratory multivariable logistic regression model restricted to high- and very-high-risk patients (moderate-risk excluded due to small numbers) and adjusted for age, sex, and diabetes duration, very high CV risk (*vs.* high) was associated with lower odds of multifactorial control (≥3 factors) (Table 4). Because established ASCVD is part of the definition of very-high risk in the ESC framework, we did not include 'history of cardiovascular disease' as a separate covariate to avoid collinearity. These analyses should be interpreted as associations rather than predictors given the cross-sectional design.

Relationship of lifestyle factors with other treatment targets

Smoking status was strongly associated with the probability of reaching the broader composite target. None of the current smokers achieved strict extended control (≥4/6), whereas 34 non-smokers (27.9%) did so (p<0.001). In addition, LDL-c target attainment was significantly more frequent in non-smokers than in current smokers (24.6% *vs.* 9.6%, p=0.024), while HbA1c, blood pressure, and triglyceride target attainment did not differ according to smoking status. With regard

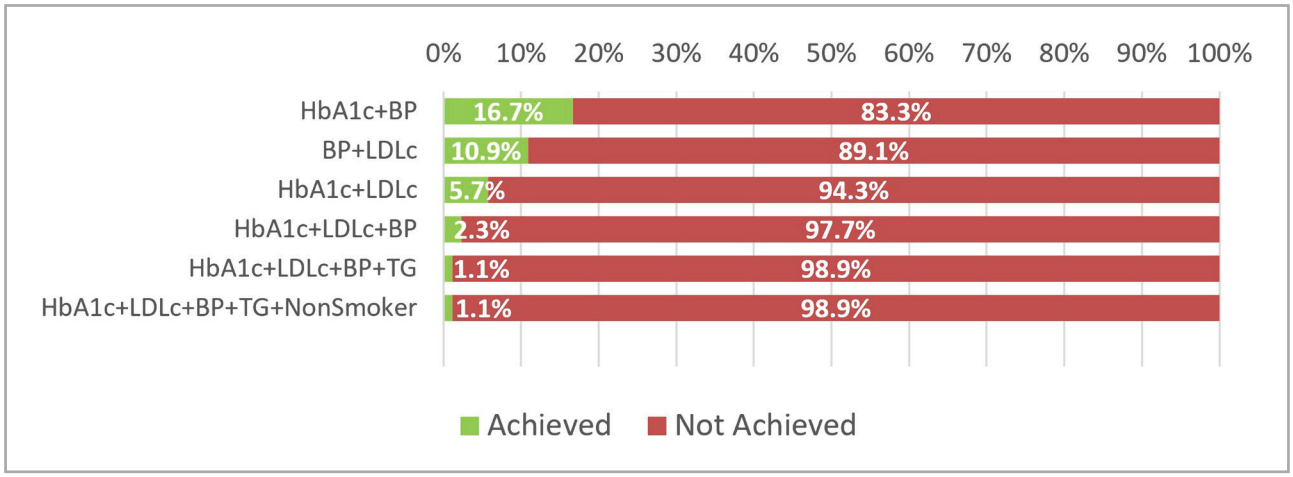

Figure 1: Control of composite modifiable cardiovascular risk factor factors in patients with T2D (HbA1c, LDL-c, triglycerides, BP, and BMI category). LDL-c – low-density lipoprotein cholesterol; BP – blood pressure; HbA1c – hemoglobin A1c; TG – triglycerides. Smoking status was recorded but was not included in the composite factor count.

Table 3: Distribution of the number of controlled modifiable CV risk factor targets by CV risk category.

Number of controlled targets	Moderate CV risk (n=7)	High CV risk (n=25)	Very high CV risk (n=142)	P-value
0	1 (14.3%)	3 (12.0%)	14 (9.9%)	0.892
1	0 (0.0%)	6 (24.0%)	47 (33.1%)	0.134
2	2 (28.6%)	6 (24.0%)	51 (35.9%)	0.487
3	4 (57.1%)	7 (28.0%)	26 (18.3%)	0.033 *
4	0 (0.0%)	3 (12.0%)	4 (2.8%)	0.084
≥3 of 5	4 (57.1%)	10 (40.0%)	30 (21.1%)	0.019 *

Note: * – Differences are statistically significant at p<0.05 threshold.

Table 4: Multivariable logistic regression for the attainment of 3 or more out of 5 modifiable CV risk factor targets.

Predictor	OR (95% CI)	P-value
Very high CV risk (*vs.* high)	0.288 (0.101–0.821)	0.020
Age (per 1 year)	1.051 (0.990–1.115)	0.103
Male sex (*vs.* female)	1.793 (0.852–3.777)	0.124
Diabetes duration (per 1 year)	0.984 (0.933–1.039)	0.564

to BMI categories, blood pressure target attainment was highest among participants with normal weight (65.0%), intermediate in those with overweight (46.0%), and lowest in those with obesity (35.9%; p=0.045). Although strict extended control was numerically more frequent in normal-weight patients than in those with obesity (35.0% *vs.* 16.5%), this difference did not reach statistical significance in the unadjusted categorical comparison (p=0.152) (Tables 5 and 6).

Discussions

Interpretation of our findings

Our findings highlight the difficulty in attaining simultaneous control of multiple cardiometabolic and lifestyle-related targets in patients with T2D. Despite being among the most important treatment goals in patients with T2D, only 5.7% of patients concurrently met the HbA1c and the risk category-based LDL-c target.

Moreover, both multifactorial (≥3/5 targets) and strict extended control (≥4/6 targets) were less attained as CV risk increased, reflecting the barriers of achieving simultaneous control of risk factors particularly in subgroups needing the most intensive management, such as patients with T2D and very high CV risk. When factors related to multifactorial control were explored in a multivariate logistic regression model, we found that the very high CV risk category was independently associated with lower odds of multifactorial risk factor control when compared to the high CV risk category, underscoring the difficulty these patients encounter in properly managing their disease, likely attributed to an

Table 5: Association between smoking status and attainment of other cardiometabolic targets.

Outcome	Current smokers	Non-smokers	P-value
HbA1c target achieved	24 (46.2%)	57 (46.7%)	1.000
LDL-c target achieved	5 (9.6%)	30 (24.6%)	0.024
Blood pressure target achieved	22 (42.3%)	51 (41.8%)	1.000
Triglyceride target achieved	30 (57.7%)	71 (58.2%)	1.000
Strict extended control (≥4/6)	0 (0.0%)	34 (27.9%)	<0.001

https://doi.org/10.46389/rjd-2026-2181

Table 6: Association between BMI category and attainment of other cardiometabolic targets.

Outcome	Normal weight	Overweight	Obesity	P-value
HbA1c target achieved	6 (30.0%)	27 (54.0%)	48 (46.6%)	0.191
LDL-c target achieved	2 (10.0%)	11 (22.0%)	21 (20.4%)	0.499
Blood pressure target achieved	13 (65.0%)	23 (46.0%)	37 (35.9%)	0.045
Triglyceride target achieved	13 (65.0%)	33 (66.0%)	54 (52.4%)	0.221
Strict extended control (≥4/6)	7 (35.0%)	9 (18.0%)	17 (16.5%)	0.152

increased burden of complications and longer diabetes duration.

Simultaneous attainment of both lifestyle-related targets (nonsmoker and normal weight) was limited, despite their favorable effect on the overall cardiometabolic profile [14, 15]. Regarding the impact of lifestyle factors on treatment targets, significant differences were found in BP control across BMI clusters, with lower BP attainment rates observed as body weight increased (65.0% with normal weight, 46.0% with overweight, and 35.9% with obesity, respectively; p=0.045). Similarly, a trend towards improved strict extended control (≥4/6 targets) was observed in patients with normal weight, reflecting the additional barrier excess adiposity imposes in optimal cardiometabolic control, although the association did not reach formal statistical significance, likely due to the limited statistical power given the small sample size in the normal weight group. Smokers were less likely to attain the strict extended control and the appropriate LDL-c targets when compared to nonsmokers, a finding that is explained by the detrimental effects smoking exerts on additional CV risk factors.

Gaps in multifactorial cardiometabolic risk factor control in T2D

Our findings highlight the challenges in achieving simultaneous control of multiple cardiometabolic risk factors in patients with T2D and are in line with international and European reports on the attainment of risk factor targets in patients with T2D [16–19]. Optimal control of potentially modifiable risk factors remains limited [17], despite being associated with improved outcomes in these patients [12]. While risk factor like glycemia and blood pressure may yield improved control rates [17, 20], lipids and body weight control impose a frequent challenge in real-world clinical practice [18, 21, 22]. LDL-c targets achievement rates vary across reports due to the criteria used for lipid targets definition and the demographic population evaluated [23, 24]. Former ESC Guidelines editions endorsed less strict lipid targets in high- and very high CV risk categories [25], resulting in greater attainment rates when these guidelines were utilized as reference target goals across studies [17, 23]. Moreover, CV risk classification plays a significant role in determining lipid targets, with differences in CV risk stratification methods translating to distinct therapeutic goals for LDL-c [26]. However, when current lipid targets were applied, attainment rates were suboptimal, with worse control observed in higher CV risk subgroups [26, 27]. Two large observational analyses conducted in European patients indicated LDL-c attainment rates of approximately 20% when the 2019 ESC Guidelines CV risk-based targets were utilized [23, 28], further highlighting the difficulty in attaining the recommended lipid targets in clinical practice. It should be noted that the 2019 and 2023 ESC Guidelines editions recommend the same lipid targets tailored to CV risk category, both in patients with and without T2D [5, 6, 29].

Excess body weight remains among the most difficult risk factors to control in patients with T2D, with studies indicating that normal weight, defined as a BMI <25 kg/m^2, is uncommon in these individuals [16, 17]. Similarly, the proportion of patients with normal weight was limited in our study, with almost 90% of the cohort having either overweight or obesity, putting an additional strain on achieving optimal cardiometabolic control in this population due to the deleterious effects excess adiposity imposes on the overall cardiometabolic profile [30, 31]. Obesity promotes peripheral insulin resistance and concomitantly affects pancreatic insulin secretion through chronic low-grade inflammation, adversely influencing the glycemic profile in patients with T2D [32, 33]. Moreover, it determines both quantitative and qualitative alterations in lipid profile by increasing circulating TG and favoring

the formation of small and dense, highly atherogenic LDL-c particles [34]. Hypertension is highly prevalent in patients with obesity, with insulin and leptin resistance and activation of neurohormonal pathways exerting an unfavorable effect on BP control [35]. As reported in our analysis, obesity was significantly associated with lower BP target achievement in patients with T2D. While our findings indicate a numerical increase in the attainment rates of strict extended control in normal-weight patients, this association lacked statistical significance. However, several other studies highlighted the influence of excess adiposity on cardiometabolic control, with lower achievement rates of risk factor targets documented in populations with T2D and obesity [31, 36, 37].

Moreover, when discussing optimal management in patients with T2D, a comprehensive and multifactorial approach targeting concurrent risk factor targets achievement is highly recommended in current guidelines [6, 7], particularly since outcomes improve with each controlled risk factor [12]. However, control of cardiometabolic risk factors and implementation of optimal therapies remain largely limited, mostly attributed to insufficient employment of guideline recommendations and preventive strategies in real-world clinical practice [19]. Simultaneous control of multiple risk factors remains difficult to achieve, as observed both in our analysis and in several other studies, further underscoring the difficulty of achieving multifactorial CV risk factor control in patients with T2D [10, 16, 38, 39]. The complex interplay between lipids, weight, blood pressure and glycemia indicates the multidirectional relationship and the shared pathophysiological substrate these cardiometabolic risk factors have [40]. All these factors stem from the same common underlying cause, namely metabolic dysfunction, characterized by the presence of excess adiposity, insulin resistance, chronic low-grade inflammation and endothelial dysfunction. Moreover, this cluster of abnormalities frequently coexist in patients with T2D and impose a real management challenge in achieving optimal cardiometabolic control [41–44].

Relationship between lifestyle-related factors and cardiometabolic control in T2D

A long-debated topic is whether achieving normal weight leads to a reduction in CV events and mortality in patients with T2D. It has been hypothesized that a potential beneficial effect of excess adiposity may exist in these patients. This “obesity paradox”, where a higher BMI is associated with lower mortality and improved outcomes in these patients, may seem rather counterintuitive given that obesity by itself is a well-established risk factor for both T2D and CVDs [45]. Excess adiposity may exert a protective effect as chronic diseases progress, with observational studies indicating a U-shaped relationship between body weight and mortality [46]. While factors like reverse causation due to associated pre-existing comorbid conditions may significantly influence the interpretation of these findings [47], in theory, an increased body weight may be beneficial in selected patients with long-standing chronic diseases [48]. This observation sparked significant debates, further augmented by the results of the Look AHEAD trial, in which body weight control through intensive lifestyle interventions failed to demonstrate a reduction in CV outcomes rates despite achievement of a significant weight loss [49]. However, several aspects should be accounted. Weight reduction is not limited to the amount of lost weight, since adherence to lifestyle interventions is sometimes difficult to maintain over the years, particularly in patients with T2D [50]. Initial mean weight reduction was 8.6% in the Look AHEAD trial, but decreased to 6% after the trial ended, indicating that long-term sustainability remains a significant challenge in weight loss [49, 51]. Moreover, newer incretin-based therapies may further contribute to a more sustained weight loss while also improving CV outcomes through mechanisms independent of weight reduction or glycemic control. Therefore, through multifactorial interventions, obesity may become an actionable target, while the use of cardioprotective agents such as GLP-1 RAs as an adjunct to lifestyle interventions may be particularly beneficial in patients with T2D and obesity at very high CV risk or with established ASCVD [52, 53]. While no formal weight target is currently recommended by scientific guidelines in patients with T2D, achievement of normal weight remains a goal quite difficult to attain, it remains strongly encouraged [53]. Further efforts to mitigate excess adiposity in this population are needed.

Smoking is an established risk factor for ASCVD through mechanisms such as increased oxidative stress, inflammation, and consequent endothelial dysfunction. Additionally, T2D is a major driver of atherosclerosis through related and often overlapping pathophysiological mechanisms [54]. As we observed in our analysis, smokers had worse LDL-c control when compared to their counterparts and were less likely to achieve the composite risk factor targets control. These findings are in line with previous reports where

 https://doi.org/10.46389/rjd-2026-2181

nonsmoking individuals with T2D had improved glycemic and lipid profile when compared to smokers [14]. Smoking is associated with increased insulin resistance, direct toxic effect on pancreatic beta cells, and consequent alterations in glucose homeostasis. Moreover, it reduces lipoprotein lipase activity, leading to elevated levels of serum TG and the formation of small dense LDL-c, while decreasing HDL-c. These metabolic alterations may explain the suboptimal control of multiple risk factors observed in smokers [55–57].

Actionable barriers in improving cardiometabolic control

As highlighted above, there is room for improvement in cardiometabolic control in patients with T2D. Since several treatment targets and therapeutic interventions are decided based on CV risk categories, risk assessment using the latest available guideline recommendations should be performed as part of any standard clinical evaluation [6]. Underestimation of CV risk is an often-overlooked cause for failure of achieving optimal risk factor control in these patients [28]. Therefore, an accurate risk assessment should preclude therapeutic decisions to ensure that the recommended targets are met, followed by the implementation of a structured plan to implement suitable treatment strategies, while also performing more frequent follow-ups in patients with higher CV risk [6, 7]. Clinical inertia is often an understated reason for unsuccessful implementation of guideline-directed medical therapy and recommendations, and the opportunity for intensification of therapeutic measures should be critically evaluated and performed when determined necessary and appropriate [58, 59]. Since T2D is a multisystemic chronic disease, a patient-centered management strategy performed in a multidisciplinary setting may translate to improved control of cardiometabolic risk factors [60–62].

Strengths and limitations of our study

Our analysis provides a snapshot of the current control of cardiometabolic and lifestyle-related risk factors in a real-world cohort of patients with T2D and a very high-risk demographic background, in whom CV risk was assessed based on the latest recommendations provided by the ESC Guidelines for patients with diabetes, with subsequent therapeutic targets defined accordingly.

Limitations are related to the cross-sectional study design, restricting the ability to establish causality between clinical factors and cardiometabolic control. Therefore, our results should be interpreted as associations rather than predictors. Additionally, treatment patterns were not formally addressed in our analysis. Longitudinal studies are warranted to establish causality between lifestyle-related factors and cardiometabolic control, alongside evaluating prescription patterns of cardioprotective therapies and treatment adherence in this population.

Conclusion

Smoking status was significantly associated with lower odds of simultaneous cardiometabolic control and lower rates of LDL-c target attainment, highlighting the importance of smoking cessation in patients with T2D. Weight targets were achieved only in a small proportion of patients with T2D. A comprehensive and multifactorial approach performed in a multidisciplinary setting that focuses on lifestyle optimization, with a particular emphasis on weight control and smoking cessation, alongside optimal control of modifiable cardiometabolic risk factors, is urgently needed in this vulnerable population.

Conflict of interest

The authors declare no conflict of interest.

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