

## Therapeutic targets achievement in secondary prevention after myocardial infarction in a North African tertiary center

### Atteinte des cibles thérapeutiques recommandées en prévention secondaire après infarctus du myocarde dans un centre tertiaire nord-africain

Faten El Ayeche Boudiche<sup>1</sup>, Selim Boudiche<sup>2</sup>, Safia Othmani<sup>3</sup>, Hajer Mehri<sup>4</sup>, Ahmed Omar Yaakoub<sup>1</sup>, Malek Larbi<sup>1</sup>, Leila Bezdah<sup>1</sup>.

1. Cardiology department, Charles Nicolle hospital, Tunis, Tunisia. Faculty of medicine of Tunis, Tunis El Manar university
2. Cardiology department, La Rabta hospital, Tunis, Tunisia. Faculty of medicine of Tunis, Tunis El Manar university
3. Emergency department, Charles Nicolle hospital, Tunis, Tunisia. Faculty of medicine of Tunis, Tunis El Manar university
4. Neurology department, Charles Nicolle hospital, Tunis, Tunisia

#### ABSTRACT

**Introduction:** Despite the demonstrated efficacy of cardiovascular (CV) preventive measures, data from international literature indicate that control of CV risk factors (RF) remains insufficient in very high-risk patients.

**Aim:** This study aimed to assess prevalence of achievement of recommended therapeutic targets for the major and modifiable CVRF 12 months after myocardial infarction (MI).

**Methods:** From 1st January to 30th April 2023, we collected consecutive patients with type 1 MI who had completed 12 months follow-up. Primary endpoint was prevalence of achievement of all recommended therapeutic targets of low-density lipoprotein cholesterol (LDL-C), diabetes mellitus (DM), arterial hypertension (HTN), and smoking. Targets and treatment goals were defined according to the 2021 European Society of Cardiology guidelines on CV disease prevention.

**Results:** 107 patients, mean age  $58.8 \pm 8.8$  years, 74.8% male, were included. 42 (39.3%) patients had HTN, 50 (46.7%) were diabetics, 77 (72.0%) were smokers and eight (7.5%) had hypercholesterolemia. At 12 months, primary endpoint was achieved in 20 (18.7%) patients. 55 (71.4%) of 77 smoker patients were weaned. Blood pressure was at target in 26 (61.9%) among hypertensive patients. In DM patients, HbA1c target was achieved in 23 (46.0%) of them. 32 patients (29.9%) achieved the goal of LDL-C  $< 0.55$  g/L.

**Conclusions:** Secondary prevention of CV disease was suboptimal. Less than a fifth of patients achieved treatment target for most major and modifiable risk factors. Improvement in follow-up care and treatment after MI is needed.

**Key words:** secondary prevention; cardiovascular risk; myocardial infarction

#### RÉSUMÉ

**Introduction:** Malgré l'efficacité des mesures de prévention cardiovasculaire (CV), le contrôle des facteurs de risque (FR) CV reste insuffisant chez les patients à très haut risque.

**Objectif:** Évaluer la prévalence de l'atteinte des cibles thérapeutiques recommandées pour les FRCV majeurs et modifiables 12 mois après un infarctus du myocarde (IDM).

**Méthodes:** Du 1er janvier au 30 avril 2023, nous avons colligé des patients consécutifs ayant eu un IDM de type 1 et ayant totalisé 12 mois de suivi. Le critère de jugement primaire (CJP) était le taux d'atteinte de toutes les cibles thérapeutiques recommandées pour le diabète, l'hypertension artérielle (HTA), le LDL-C et le tabagisme. Les cibles thérapeutiques ont été définies conformément aux recommandations de la Société Européenne de Cardiologie de 2021.

**Résultats:** 107 patients, d'âge moyen  $58,8 \pm 8,8$  ans, 74,8% de sexe masculin, ont été inclus. 42 (39,3%) avaient une HTA, 50 (46,7%) étaient diabétiques, 77 (72,0%) étaient fumeurs et huit (7,5%) avaient une hypercholestérolémie. À 12 mois, le CJP était atteint chez 20 (18,7%) patients. 55 (71,4%) des 77 patients fumeurs étaient sevrés. La pression artérielle était à la cible chez 26 (61,9%) patients parmi les hypertendus. Chez les patients diabétiques, l'objectif d'HbA1c était atteint chez 23 (46,0%) d'entre eux. 32 patients (29,9%) ont atteint l'objectif de LDL-C  $< 0,55$  g/l.

**Conclusions:** La prévention secondaire des maladies CV était suboptimale. Moins du cinquième des patients ont atteint l'objectif thérapeutique pour les FRCV modifiables. Il est nécessaire d'améliorer la prise en charge après IDM.

**Mots clés:** prévention secondaire ; risque cardiovasculaire ; infarctus du myocarde

#### Correspondance

Faten El Ayeche Boudiche

Cardiology department, Charles Nicolle hospital, Tunis, Tunisia. Faculty of medicine of Tunis, Tunis El Manar university

Email: faten.elayech@gmail.com

## INTRODUCTION

Major and modifiable cardiovascular risk factors (CVRF) for atherosclerotic CVD are dyslipidemia, particularly low-density lipoprotein cholesterol (LDL-C), hypertension (HTN), diabetes mellitus (DM), and smoking (1–4). Tunisian myocardial infarction (MI) patients' cohorts are frequently associated with a high prevalence of modifiable CVRF (4).

Despite the demonstrated efficacy of preventive measures, data from the international literature indicate that control of CVRF remains insufficient, particularly in high-risk and very high-risk patients (5–9). In fact, many patients with coronary artery disease (CAD) do not benefit from the therapeutic interventions recommended in the guidelines to achieve secondary prevention goals. This insufficient control of CVRF has a multifactorial cause and is associated in the literature with excess morbidity and mortality (1–3).

Cardiovascular education and rehabilitation programs proposed for this aim after MI are designed to reinforce pharmacological measures for secondary prevention, as well as to encourage the patient to adopt healthy lifestyle habits (10). Such programs are costly and often not reimbursed, as public centers are not available in Tunisia. To date, and to the best of our knowledge, scarce data about secondary CV prevention are available in Tunisia, as only the difficulty of reaching therapeutic target of LDL-C after acute coronary syndrome has been treated in a Tunisian multicenter study (7).

The aim of this study was to assess the prevalence of achievement of recommended therapeutic targets for major and modifiable CVRF in secondary prevention after ST-segment elevation (STEMI) or non-ST-segment elevation MI (NSTEMI) assessed 12 months after index hospitalization for MI in a tertiary center in Tunisia.

## METHODS

This was an observational, descriptive, cross-sectional, monocentric study, carried out in a cardiology department of a tertiary university hospital from January 1 to April 30, 2023. The primary objective of the study was to estimate the rate of achievement of recommended therapeutic targets, 12 months after MI, regarding the major and modifiable CVRF, namely LDL-C, HTN, DM, and smoking. Secondary objectives were to evaluate separately the rate of achievement of each component of the primary endpoint. Each therapeutic target was investigated separately, in order to distinguish any disparities between risk factors control, and thus to better plan future actions to be taken with regard to each component of the primary criterion.

We included consecutive patients with acute type 1 MI with or without ST-segment elevation, who achieved 12 months follow up after the index event. All patients signed an informed consent before being included in the study. We did not include patients with prior CAD to the index event, type 2 MI, patients who died during hospitalization or within the 12 months after the index event, patients

not investigated by coronary angiography and patients who could not be reached for the 12 months evaluation of the primary and secondary endpoints criteria. We excluded patients who did not attend the follow-up visit despite 3 requests, as well as patients with unexploitable or missing data regarding the study endpoints.

The primary endpoint was a composite criterion and represented the rate of achievement of all recommended treatment targets of LDL-C, HTN, DM, and smoking 12 months after MI.

The target and treatment goals were defined according to the 2021 European Society of Cardiology guidelines on CVD prevention (11) as follows:

- For DM: a glycated hemoglobin (HbA1c) of 7% in all diabetic patients except frail patients aged  $\geq 70$  years, or with significant comorbidities, or those with multivessel CAD not or incompletely revascularized, or with another established CVD... in these cases, an HbA1c of 8% may be tolerated, avoiding hypoglycemia in all cases.

- For HTN: we opted for office systolic blood pressure (SBP) and diastolic blood pressure (DBP) measurements according to the recommended protocol, with the target defined as follows:

- o 18-69 years: a SBP of 130 mmHg or less if tolerated, but not  $<120$  mmHg and a DBP of 70-79 mmHg.

- o  $\geq 70$  years: a SBP of 130-139 mmHg if tolerated and a DBP of 70-79 mmHg.

- For dyslipidemia: in this study, we were interested in LDL-C levels, whose causal role in atherosclerotic CVD has been well established. Determination of LDL-C was based on a blood sample taken after 12 hours of fasting, calculated according to standard formulae including blood triglycerides and High-density lipoprotein cholesterol levels, and expressed in g/l (11). The LDL-C target is defined as follows: LDL-C  $< 0.55$  g/l and a reduction  $\geq 50\%$  compared with initial LDL-C in all patients, irrespective of age (12,13).

- For smoking: total and sustained cessation of tobacco intoxication and avoidance of passive smoking at least since the index event.

- In addition, we assessed patients' body mass index (BMI) at baseline and at 12 months. BMI  $\geq 25$  Kg/m<sup>2</sup> was considered as pathological, and patients were considered obese when BMI was  $\geq 30$  Kg/m<sup>2</sup>.

We recruited patients for this study from the admissions register of the cardiology department.

All patients were convoked for a follow-up visit 12 months after the index event. Items identified at the follow-up visit for the primary and secondary endpoints were as follows:

- Anamnestic data on smoking cessation, medication use and compliance.

- Physical examination, following the recommended rules for measuring office blood pressure (BP) with an automatic tensiometer, and in the case of arrhythmia with a manual tensiometer (14), measuring heart rate, weight, and height.

- A standardized prescription of biological check-up, including HbA1c, glycemia, total cholesterol, HDL-C and triglycerides after 12 hours of fasting, as well as transaminase for all patients on statin therapy, and a

complete blood count for all patients on antithrombotic therapy.

Data were collected and analyzed using IBM SPSS Statistics software. Qualitative variables were expressed as absolute and relative frequencies, and quantitative variables as means and standard deviations or medians and interquartile ranges [Q1; Q3]. Comparisons of 2 means on independent samples were made using Student's t-test for independent samples, and in the case of small numbers by the non-parametric Mann Whitney test. Comparisons of 2 percentages on independent samples were made by Pearson's chi-square test, and in the event of significance in the chi-square test and non-validity of this test, by Fisher's two-tailed exact test. To identify primary endpoint predictors, a multivariate analysis using logistic regression was performed. At univariate analysis, the following variables were assessed: age, gender, socio-economic category, educational level, social care regimen, clinical presentation, MI complications, hospital stay duration, number of medical visits within the 12-month follow-up. Age, gender and variables with  $p < 0.2$  were included into a multivariate model. In all statistical tests, the significance threshold was set at 0.05.

## RESULTS

During study period, 107 patients were included. Baseline population characteristics are summarized in Table 1.

Regarding major and modifiable CVRF identified on admission, 77 (72.0%) patients were smokers among whom 73 (68.2%) were current smokers. The average number of pack-years was  $44.1 \pm 23$ . Furthermore, 50 (46.7%) patients were diabetic, including 2 (1.9%) with first-onset DM, 42 (39.3%) were hypertensive, eight (7.5%) patients had a history of hypercholesterolemia and were under cholesterol-lowering treatment for primary prevention. It is of note that 68 (63.6%) patients had a body mass index  $\geq 25 \text{ kg/m}^2$  and 28 (26.2%) were obese. None of the patients were drug addicts.

Initial presentation was a NSTEMI and STEMI in 58 (54.2%) and 49 (45.8%) patients respectively. Among patients with acute STEMI, 15 (31.9%) underwent fibrinolysis, which was successful in 11 (10.3%) patients, while primary percutaneous coronary intervention (PCI) was indicated in 17 (15.9%) and rescue PCI in 4 (3.7%) patients.

The mean left ventricle ejection fraction (LVEF) was  $52.7 \pm 9.6\%$  with a reduced LVEF  $< 40\%$  noted in 18 (16.8%) patients.

All patients underwent coronary angiography. Coronary lesions were observed in all patients, of which 3 (2.8%) were non-obstructive, 52 (48.6%) single-vessel, 32 (29.9%) two-vessel and 20 (18.7%) three-vessel disease.

Myocardial revascularization was performed in 75 (70.1%) patients including 74 (69.2%) PCI and 1 (0.9%) coronary artery bypass grafting. Thirty-two (29.9%) patients were treated medically, among them 10 (9.3%) had a myocardial revascularization indication but not yet performed at the time of 12-month follow-up consisting of 1 (0.9%) PCI and 9 (8.4%) bypass surgery pending indications.

**Table 1.** Baseline characteristics of the study population

Population characteristics	Baseline
Age (Years)	58.8 $\pm$ 8.8
Gender (men)	74.8%
Modifiables CVRF	
• Smoker	77 (72.0%)
• Diabetes mellitus	50 (46.7%)
• HTN	42 (39.3%)
• Dyslipidemia	8 (7.5%)
• BMI $\geq 25$	68 (63.6%)
• Obesity	28 (26.2%)
Comorbidities	
• Chronic kidney disease	16 (15.0%)
• Chronic obstructive pulmonary disease	6 (5.6%)
• Peripheral arterial disease	5 (4.7%)
• Stroke	3 (2.8%)
• Atrial fibrillation	1 (0.9%)
• Sleep obstructive apnea syndrome	1 (0.9%)
• Cancer	3 (2.8%)
Clinical presentation	
• NSTEMI	58 (54.2%)
• STEMI	49 (45.8%)
• LVEF (%)	52.7 $\pm$ 9.6
• Coronary status	
o No obstructive disease	3 (2.8%)
o Single vessel disease	52 (48.6%)
o 2-vessel disease	32 (29.9%)
o 3-vessel disease	20 (18.7%)
• Myocardial revascularization	
o PCI	74 (69.2%)
o CABG	1 (0.9%)
o Medical treatment	32 (29.9%)
▪ PCI indicated but not performed	5 (4.7%)
▪ CABG indicated but not performed	9 (8.4%)

BMI: body mass index; CABG: coronary artery bypass graft; CVRF: cardiovascular risk factors; HTN: hypertension; LVEF: left ventricular ejection fraction; NSTEMI: non ST-segment elevation MI; PCI: percutaneous coronary intervention; STEMI: ST-segment elevation MI

Only one patient (0.9%) benefited from cardiac rehabilitation program. The primary endpoint was reached in 20 (18.7%) patients. CVRF at targets at 12 months post MI are exposed in tables 2 and 3.

**Table 2.** Cardiovascular risk factors at baseline and at 12 months after myocardial infarction in the study population

	Baseline	At 12 months	P value
Diabetes			
• HbA1c (%)	8,7 $\pm$ 1,7	7,6 $\pm$ 1,5	0,001
Dyslipidemia			
• Total cholesterol (g/L)	1,7 $\pm$ 0,4	1,4 $\pm$ 0,4	2.10 <sup>-7</sup>
• Triglycerides (g/L)	1,6 $\pm$ 0,9	1,2 $\pm$ 0,5	5.10 <sup>-9</sup>
• HDL-C (g/L)	0,35 $\pm$ 0,9	0,4 $\pm$ 0,1	0.0003
• LDL-C (g/L)	1,0 $\pm$ 0,4	0,8 $\pm$ 0,4	2.10 <sup>-7</sup>
HTN			
• Systolic blood pressure (mmHg)	—	128.7 $\pm$ 13.2	NA
• Diastolic blood pressure (mmHg)	—	72.7 $\pm$ 9.4	NA
Smoker			
• Current	73 (68,2%)	12 (15,6%)	
• Weaned	4 (3,7%)	55 (71,4%)	
Weight (Kg)	74.3 $\pm$ 12.9	74.7 $\pm$ 12.3	0.47
• BMI $\geq 25 \text{ Kg/m}^2$	68 (63.6%)	73 (68.2%)	0.471
• Obesity	28 (26.2%)	24 (22.4%)	0.524

BMI: body mass index; HbA1c: glycated hemoglobin; HDL-C: high-density lipoprotein cholesterol; HTN: hypertension; LDL-C: low-density lipoprotein cholesterol.

**Table 3.** Cardiovascular risk factors at targets at 12 months after myocardial infarction in the study population

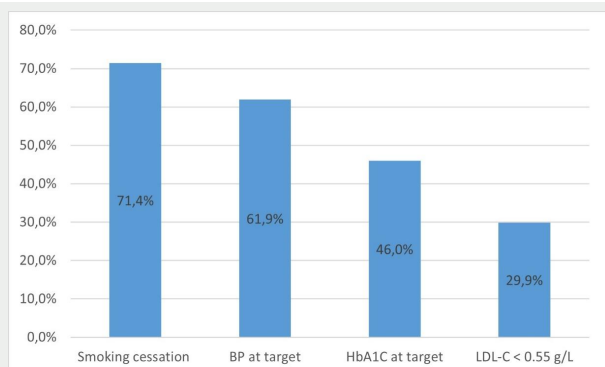
Target achievement (%)	All patients (N=107 patients)	Smoking patients (N=77)	DM patients (N=50)	Hypertensive patients (N=42)
Blood pressure	63 (58.9%)	—	—	26 (61.9%)
LDL-C	32 (29.9%)	—	—	—
HbA1c	—	—	23 (46%)	—
Non-smoking	—	55 (71.4%)	—	—

HbA1c: glycated hemoglobin; LDL-C: low-density lipoprotein cholesterol.

Only the socio-economic category by salary range  $\geq 1000$  dinars/month was associated in multivariate analysis with achieving the primary endpoint,  $p=0.006$ ,  $OR=5.7$ ,  $CI95\%$ , [1,7-19.4].

At 12 months, 55 among the 77 smoking patients (71.4%) quit smoking and the average cessation duration was  $14.3 \pm 11.9$  months (Figure 1).

At 12 months, BP was at target in 26 (61.9%) among hypertensive patients and in 63 (58.9%) of all the study population. 21 (19.6%) had BP levels above target with grade 1 or 2 HTN. 23 (21.5%) had BP levels below target with an average SBP of  $116.5 \pm 8.6$  mmHg and/or DBP at  $64.0 \pm 5.3$  mmHg. Among this last category of patients, 5 (4.7%) were aged over 70 years and none of them had symptoms of hypotension. 2 (1.9%) of the patients practiced home BP monitoring and in whom the BP was on target and none of the patients had benefited from an ambulatory BP monitoring (Figure 1).

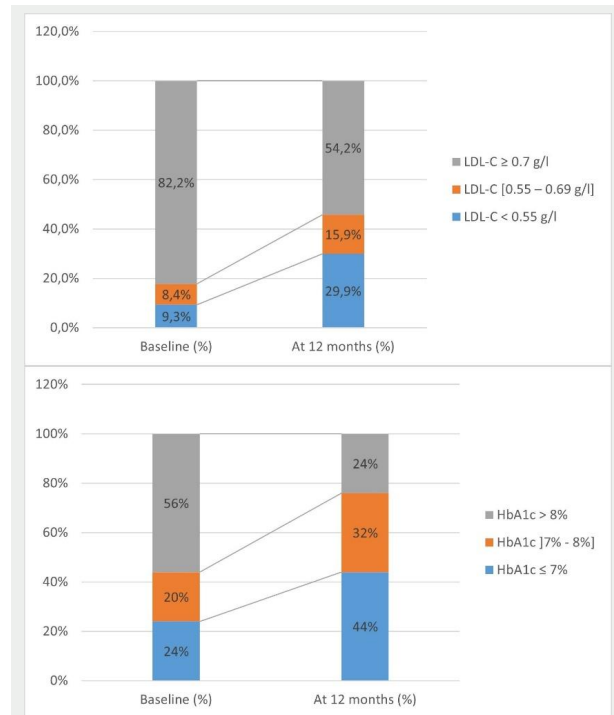


**Figure 1.** Targets achievement

At 12 months, among the 50 diabetic patients, HbA1c goal was reached in 23 (46.0%) of them. 42 (84%) patients were followed by a diabetologist, 6 (12%) by a primary care physician and 2 (4%) were out of follow-up. Among poorly balanced diabetic patients, therapeutic escalation was undertaken in 51.3% of cases. At 12 months, only 3 (2.8%) patients were on sodium-glucose cotransporter-2 (SGLT2) Inhibitors and none on glucagon-like peptide 1 (GLP-1) receptor agonists (Figures 1 and 2).

At 12 months, 32 patients (29.9%) achieved the goal of LDL-C < 0.55 g/l and 14 (13.1%) achieved the combined goal of LDL-C < 0.55 g/l and  $\geq 50\%$  LDL-C reduction. At the end of follow-up, 105 (98.1%) patients were on atorvastatin at a dosage of 40 mg and 2 (1.9%) patients were stopping lipid-lowering treatment on their own initiative. All patients in whom LDL-C was not at target were on non-maximum doses of statins and 18 (16.8%) were not compliant with their treatment, despite the absence of side effects. None of the patients were under

treatment with Ezetimibe (Figures 1 and 2).



**Figure 2.** LDL-C and HbA1C values

## DISCUSSION

The main finding of this cross-sectional study led in patients with previous MI is that a heterogenous and suboptimal proportion of less than a fifth of patients reached the European treatment targets for secondary prevention. Our evaluation of goals attainment of major and modifiable CVRF in secondary prevention 12 months after MI provided several important findings:

First, despite a very high cardiovascular risk, the mean number of achieved goals of major and modifiable CVRF was low. In total, 18.7% of the participants achieved the treatment targets for all CVRF combined (LDL-C, BP, DM, and smoking)

Second, in analysis of single CVRF treatment targets, prevalence of target achievement for every CVRF varied in the total sample. Smoking cessation was achieved in 71.4% of smokers. BP was at goals in 61.9% of hypertensive patients. Among patients with DM, 46% reached the HbA1c target level. The lowest proportion was found for LDL-C (29.9%).

Third, only one patient benefited from cardiac rehabilitation program.

Finally, drug therapies targeting LDL-C, DM, and BP were not optimal and needed to be improved.

Our results are coherent with previous findings from large international multicenter and registry studies (5,15–18). In a large Norwegian register which investigated European guideline treatment target achievement in CVRF, medication use, and lifestyle, after MI or ischemic stroke, Hopstock and al. found that <1% of patients achieved the treatment target of both BP, LDL-C, and overweight combined, which was in line with findings from a nation-wide Norwegian register-based analysis of CVRF



control at admission for acute MI for patients with prior CAD (19). Moreover, in Norway, register-based studies showed that one out of four acute MI hospitalizations are recurrent events (5,19). It is worth noting that in Norway more than 90% of all patients with MI are prescribed the guideline-recommended medications at hospital discharge (5,20), and more than 90% of patients also collect their medications at pharmacies within 6 months after the event (20).

At the opposite, a large proportion of patients consulting at public hospitals in Tunisia remain without adequate social security policy not allowing a therapeutic regimen that is stable over time or in accordance with the European guidelines required yet at discharge of these patients. Furthermore, cardiology consultations following MI are very spaced out in time with time allocated to each consultant not allowing emphasis on the aspect of secondary prevention.

In the French CORONOR registry (1) including stable coronary patients, it was demonstrated that continued smoking was an independent predictive factor for the occurrence of MI with a risk that was doubled. Likewise, poor control of LDL-C or HbA1c (in the case of DM) would independently increase the risk of MI. This risk was increased by 6% for each increase of 0.1g/l in LDL-C and was 60% as soon as the HbA1c reached 7%. These data have been corroborated by several international studies (2,3).

Regarding LDL-C targets, only 46% out of 100 patients reached the 0.55 g/L target and 33% of them reduced their LDL-C levels of more than 50% after 4 to 6 weeks after MI in a recent Tunisian report (7). This was in accordance with the suboptimal LDL-C control at 12 months in our series with only 29.9% of patients at the LDL-C < 0.55 g/L goal.

A Korean Nationwide Cohort Study investigated LDL-C targets achievement impact on two-year major adverse cardiac and cerebrovascular event (MACCE). Target achievers had significantly lower incidence of MACCE (2.2% vs. 3.5%, log-rank  $p = 0.022$ ) and a reduced adjusted hazard of MACCE (0.63;  $p = 0.041$ ). These results highlighted the need to improve current practices for managing LDL-C levels in real-world settings (21).

In this series, patients with DM constituted nearly half of all individuals. There were 1.9% of patients with DM diagnosed during the index event hospitalization. Thus, the screening failure was a cause of delay in diagnosis and more intensive treatment or lifestyle modifications. The BP values were at recommended therapeutic target in approximately 60% of the cases in our study population. In a cohort of 87 Senegalese patients evaluated at least 6 months after an MI (8), BP target achievement was, compared to our results, lower by around 28%, while the prevalence of HTN in this series was higher (57.5% Vs. 39.3% in our study).

Our study provided the most recent results on a real-life therapeutic effect in secondary prevention among Tunisian patients with MI. The main strength of our study is that it was performed using standardized interviews rather than retrospective medical records only.

### Study limitations

- Monocentric design.
- A relatively small number of patients.
- Representativity of the sample is therefore limited, given that the study population issued from a single tertiary university hospital, with socio-economic characteristics specific to the population being recruited and generalizing results to the Tunisian population require a multicenter study covering all healthcare levels and socio-economic categories.
- Unavailability of public cardiac rehabilitation centers which constitutes a barrier to therapeutic education and secondary prevention programs after MI.
- Unavailability of ambulatory BP measurement to overcome the white coat effect, particularly for grade 1 HTN.
- Hospital laboratory may have run out of reagents and some tests were performed at the patient's expense.
- Limited socio-cultural and economic levels of this study population may have constituted a selection bias compared to the entire Tunisian population.
- Routine cardiology consultation appointments which are often very spaced and contain a large number of consultants leaving no room for therapeutic education of these patients.
- Moreover, patients at higher risk who died within the first months after hospitalization might have presented even worse attainment of therapeutic goals.

## CONCLUSION

In this analysis of secondary prevention after MI in a Tunisian tertiary center population-based sample, treatment target achievement was heterogenous and suboptimal for CVRF, and medication use. Less than a fifth of patients attained combined goals for LDL-C, BP, HbA1c, and smoking cessation. Therapeutic patient education and rehabilitation programs need to be implemented to improve long-term morbi-mortality after MI. A national multicenter large-scale registry should be designed to validate our findings in order to alert health policymakers about the need for intensified improvement in follow-up care and treatment of patients after MI.

### ABREVIATIONS

**BP:** blood pressure  
**CAD:** coronary artery disease  
**CVD:** cardiovascular disease  
**CVRF:** cardiovascular risk factors  
**DBP:** diastolic blood pressure  
**DM:** diabetes mellitus  
**LDL-C:** low-density lipoprotein cholesterol  
**MACCE:** major adverse cardiac and cerebrovascular event  
**MI:** myocardial infarction  
**NSTEMI:** non ST-segment elevation MI  
**PCI:** percutaneous coronary intervention  
**SBP:** systolic blood pressure  
**STEMI:** ST-segment elevation MI

## REFERENCES

- Lemesle G, Tricot O, Meurice T, Lallemand R, Delomez M, Equine O, et al. Incident Myocardial Infarction and Very Late Stent Thrombosis in Outpatients With Stable Coronary Artery Disease. *J Am Coll Cardiol*. mai 2017;69(17):2149-56.
- Vidal-Petiot E, Ford I, Greenlaw N, Ferrari R, Fox KM, Tardif JC, et al. Cardiovascular event rates and mortality according to achieved systolic and diastolic blood pressure in patients with stable coronary artery disease: an international cohort study. *The Lancet*. 29 oct 2016;388(10056):2142-52.
- Abtan J, Bhatt DL, Elbez Y, Sorbets E, Eagle K, Ikeda Y, et al. Residual Ischemic Risk and Its Determinants in Patients With Previous Myocardial Infarction and Without Prior Stroke or TIA: Insights From the REACH Registry. *Clin Cardiol*. 2 sept 2016;39(11):670-7.
- Boudiche S, Guermazi O, Ayech FE, Halima MB, Aouinti MA, Ouaghlani K, et al. Outcome predictors of cardiogenic shock complicating ST-segment elevation myocardial infarction Facteurs pronostiques du choc cardiogénique compliquant l'infarctus du myocarde avec sus-décalage du segment ST. *Tunis Med*. 2019;97.
- Hopstock LA, Morseth B, Cook S, Eggen AE, Grimsgaard S, Lundblad MW, et al. Treatment target achievement after myocardial infarction and ischaemic stroke: cardiovascular risk factors, medication use, and lifestyle: the Tromsø Study 2015–16. *Eur J Prev Cardiol*. 11 mars 2022;29(2):362-70.
- Haberka M, Jankowski P, Kosior DA, Szpakowicz M, Szóstak-Janiak K, Koziół P, et al. Treatment goal attainment for secondary prevention in coronary patients with or without diabetes mellitus – Polish multicenter study POLASPIRE. *Arch Med Sci AMS*. 23 janv 2020;19(2):305-12.
- Ibn Elhadj Z, Cherif N, Bennour E, Antit S, Echaieb W, Zakhama L, et al. Can we achieve ESC 2019 guidelines LDL-cholesterol target in Tunisia? *Tunis Médicale*. févr 2022;100(2):156-60.
- Evaluation du contrôle des facteurs de risque cardio-vasculaire modifiables après un infarctus du myocarde : Etude transversale à propos de 87 cas. [Internet]. [cité 16 nov 2023]. Disponible sur: <https://tropical-cardiology.com/Accueil/index.php/2013-08-10-06-44-55/n-152-avr-mai-juin-2018/199-evaluation-du-controle-des-facteurs-de-risque-cardio-vasculaire-modifiables-apres-un-infarctus-du-myocarde-etude-transversale-a-propos-de-87-cas>
- Underberg J, Toth PP, Rodriguez F. LDL-C target attainment in secondary prevention of ASCVD in the United States: barriers, consequences of nonachievement, and strategies to reach goals. *Postgrad Med*. 17 nov 2022;134(8):752-62.
- Makita S, Yasu T, Akashi YJ, Adachi H, Izawa H, Ishihara S, et al. JCS/JACR 2021 Guideline on Rehabilitation in Patients With Cardiovascular Disease. *Circ J*. 23 déc 2022;87(1):155-235.
- Visseren FLJ, Mach F, Smulders YM, Carballo D, Koskinas KC, Böck M, et al. 2021 ESC Guidelines on cardiovascular disease prevention in clinical practice. *Eur Heart J*. 7 sept 2021;42(34):3227-337.
- Gencer B, Marston NA, Im K, Cannon CP, Sever P, Keech A, et al. Efficacy and safety of lowering LDL cholesterol in older patients: a systematic review and meta-analysis of randomised controlled trials. *The Lancet*. 21 nov 2020;396(10263):1637-43.
- Armitage J, Baigent C, Barnes E, Betteridge DJ, Blackwell L, Blazing M, et al. Efficacy and safety of statin therapy in older people: a meta-analysis of individual participant data from 28 randomised controlled trials. *The Lancet*. 2 févr 2019;393(10170):407-15.
- Williams B, Mancia G, Spiering W, Agabiti Rosei E, Azizi M, Burnier M, et al. 2018 ESC/ESH Guidelines for the management of arterial hypertension. *Eur Heart J*. 1 sept 2018;39(33):3021-104.
- Kotseva K, De Backer G, De Bacquer D, Rydén L, Hoes A, Grobbee D, et al. Lifestyle and impact on cardiovascular risk factor control in coronary patients across 27 countries: Results from the European Society of Cardiology ESC-EORP EUROASPIRE V registry. *Eur J Prev Cardiol*. mai 2019;26(8):824-35.
- Kotseva K. The EUROASPIRE surveys: lessons learned in cardiovascular disease prevention. *Cardiovasc Diagn Ther*. déc 2017;7(6):633-9.
- Ferrari R, Ford I, Greenlaw N, Tardif JC, Tendera M, Abergel H, et al. Geographical variations in the prevalence and management of cardiovascular risk factors in outpatients with CAD: Data from the contemporary CLARIFY registry. *Eur J Prev Cardiol*. août 2015;22(8):1056-65.
- Cacoub PP, Zeymer U, Limbourg T, Baumgartner I, Poldermans D, Röther J, et al. Effects of adherence to guidelines for the control of major cardiovascular risk factors on outcomes in the REduction of Atherothrombosis for Continued Health (REACH) Registry Europe. *Heart*. 15 avr 2011;97(8):660-7.
- Jortveit J, Halvorsen S, Kaldal A, Pripp AH, Govatsmark RES, Langørgen J. Unsatisfactory risk factor control and high rate of new cardiovascular events in patients with myocardial infarction and prior coronary artery disease. *BMC Cardiovasc Disord*. 28 mars 2019;19(1):71.
- Jortveit J, Halvorsen S, Langørgen J. Pharmacy-dispensed drugs for secondary prevention after myocardial infarction. *Tidsskr Den Nor Legeforening* [Internet]. 9 mars 2020 [cité 16 nov 2023]; Disponible sur: <https://tidsskriftet.no/en/2020/03/originalartikkel/pharmacy-dispensed-drugs-secondary-prevention-after-myocardial-infarction>
- Kim JH, Cha JJ, Lim S, An J, Kim MN, Hong SJ, et al. Target Low-Density Lipoprotein-Cholesterol and Secondary Prevention for Patients with Acute Myocardial Infarction: A Korean Nationwide Cohort Study. *J Clin Med*. 8 mai 2022;11(9):2650.