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Lifestyle Risk Exposures, Cardiovascular Medication Use, and Documented Follow-up Indicators Among Libyan Adults Undergoing Coronary Assessment: A Multicentre Retrospective Study

Running title: Cardiovascular Risk Management in Libya

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Abstract

Background: Cardiovascular risk in patients referred for coronary assessment is shaped by the coexistence of cardiometabolic disease, behavioural exposures, medication use, and the availability of documented follow-up information. Integrated evidence from Libyan referral populations is limited.

Objective: To describe lifestyle and dietary risk exposures, cardiometabolic comorbidity, cardiovascular medication use, recorded cardiac interventions, and documented follow-up indicators among Libyan adults undergoing clinically indicated coronary assessment.

Methods: This secondary descriptive analysis used records from a multicentre retrospective cohort of 200 adults aged 26–85 years evaluated at Tripoli Medical Centre, Benghazi Medical Centre, and Tajoura Heart Centre during 2024–2025. Variables were abstracted using a structured instrument and summarised as means, frequencies, percentages, and Wilson 95% confidence intervals.

Results: Participants had a mean age of 56.4 ± 12.8 years; 84.5% were male and 89.0% were overweight or obese. Low vegetable intake was recorded in 80.0%, high red-meat intake in 86.0%, frequent trans-fat intake in 81.5%, low omega-3 intake in 84.0%, and sedentary behaviour in 78.5%. Current or former smoking was reported by 55.5%. Hypertension, hyperlipidaemia, and diabetes mellitus were present in 83.0%, 89.0%, and 43.0%, respectively. Statins were used by 90.5% and antiplatelet agents by 84.0%, whereas beta-blockers and other

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cardiovascular medicines were recorded in 39.0% and 46.0%. Subsequent cardiac interventions were recorded in 12.5%. ECG changes were present in 78.0%, while ejection fraction and inflammatory markers were documented in 48.5% and 57.0%, respectively.

Conclusion: This referral-based cohort showed marked clustering of documented modifiable lifestyle and cardiometabolic risks alongside frequent cardiovascular medication use. The findings support prospective evaluation of integrated lifestyle, medication, and follow-up pathways in Libyan cardiac referral settings. They should not be interpreted as population prevalence estimates, evidence of treatment appropriateness, or causal relationships.

Keywords: Cardiovascular risk; Lifestyle; Diet; Medication use; Follow-up indicators; Libya

Introduction

Cardiovascular diseases remain the leading global cause of death and disability. Their major modifiable determinants include tobacco exposure, unhealthy diet, physical inactivity, excess adiposity, raised blood pressure, dysglycaemia, and abnormal blood lipids (World Health Organization [WHO], 2025). These determinants rarely occur in isolation. In patients reaching specialist coronary assessment, several behavioural and biological risks may coexist, increasing the need for coordinated lifestyle, pharmacological, and monitoring strategies.

The INTERHEART study demonstrated that a limited set of potentially modifiable factors accounts for most of the population-attributable risk of acute myocardial infarction across diverse world regions (Yusuf et al., 2004). Contemporary prevention guidance likewise places healthy diet, regular physical activity, smoking cessation, blood-pressure control, lipid lowering, and diabetes management at the centre of cardiovascular risk reduction (Visseren et al., 2021; Vrints et al., 2024). Medication use therefore needs to be interpreted alongside residual behavioural exposures rather than as a substitute for lifestyle intervention.

Libya is undergoing a substantial noncommunicable-disease transition. The national WHO STEPS survey conducted in 2022–2023 documented widespread inadequate fruit and vegetable intake, insufficient physical activity, tobacco exposure, excess weight, raised blood pressure, dysglycaemia, and lipid abnormalities among adults aged 18–69 years (WHO, 2023). A recent study of western Libyan patients also identified hypertension, diabetes, and smoking as prominent contributors to coronary artery disease (Bheleel et al., 2025). However, population surveys and disease-specific studies do not fully describe how dietary exposures, activity, smoking, comorbidity, cardiovascular medicines, cardiac interventions, and follow-up indicators coexist in patients already referred for coronary assessment.

A risk-management profile of this referral population may identify areas in which intensive pharmacotherapy coexists with persistent modifiable exposures or uneven clinical documentation. The present study therefore aimed to describe lifestyle and dietary risk exposures, cardiometabolic comorbidities, cardiovascular medication use, subsequent recorded

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cardiac interventions, and selected documented follow-up indicators among Libyan adults undergoing clinically indicated coronary assessment at three major cardiac referral centres.

Materials and Methods

Study Design and Setting

This was a secondary descriptive analysis of a multicentre, retrospective, observational cross-sectional cohort. Records were obtained from Tripoli Medical Centre, Benghazi Medical Centre, and Tajoura Heart Centre in Libya. The participating institutions are major cardiac referral centres with coronary imaging and catheterisation services. Records acquired during 2024–2025 were reviewed.

Study Population

Adults aged 18 years or older who underwent clinically indicated coronary assessment and had sufficient core demographic and clinical documentation for inclusion were eligible; lifestyle, medication, intervention, and follow-up variables were analysed as recorded in the available clinical records. The source cohort initially contained 221 candidate records. Fifteen duplicate records and six paediatric records were removed, leaving 200 adults aged 26–85 years for analysis. Records with non-retrievable core variables, prior coronary artery bypass grafting before the index coronary assessment, or complex congenital heart disease unrelated to the study pathway were excluded. All eligible records in the verified adult cohort were included; no additional sample-size calculation was undertaken for this secondary descriptive analysis.

Data Collection and Quality Assurance

Data were captured using a structured, piloted extraction instrument developed for retrospective review of clinical records and coronary-assessment documentation. Lifestyle and dietary information was abstracted from the documentation available in the source records, including clinician-recorded history and patient-reported information where documented. The present analysis used demographic variables; body mass index (BMI); dietary and lifestyle exposures; hypertension, diabetes mellitus, hyperlipidaemia, and family history of coronary artery disease; current cardiovascular medication classes; subsequent cardiac interventions recorded after the index coronary assessment; and selected follow-up indicators.

Approximately 10% of records were independently double-abstracted by trained reviewers, and discrepancies were adjudicated against the original source reports before final analysis. No directly identifying information was included in the analytical dataset.

Variables and Operational Definitions

Dietary exposures were coded according to the original structured instrument as low fresh-vegetable intake, high red-meat intake, frequent trans-fat intake, and low omega-3 fatty-acid intake. The source records did not provide uniform gram-per-day thresholds for these binary

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categories; they are therefore reported as documented exposures rather than quantitatively validated dietary measures. Physical activity was classified as sedentary, moderate, or high. Smoking status was classified as current, former, or non-smoker; current and former smokers were additionally combined descriptively as ever smokers.

BMI categories were those recorded in the source dataset: underweight, normal weight, overweight, and obese. Family history was classified as first-degree, second-degree, or none. Medication classes included statins, antiplatelet agents, beta-blockers, and other cardiovascular drugs such as angiotensin-converting-enzyme inhibitors or angiotensin-receptor blockers, calcium-channel blockers, nitrates, and diuretics. Medication categories were not mutually exclusive.

Subsequent cardiac interventions recorded after the index coronary assessment were grouped as percutaneous coronary intervention or stenting, coronary artery bypass grafting, transcatheter aortic valve implantation or pacemaker treatment, and other interventions; prior coronary artery bypass grafting before the index assessment was an exclusion criterion (see Study Population). Follow-up variables described whether ECG changes were present and whether ejection fraction and inflammatory-marker information was documented. These indicators do not by themselves establish the clinical appropriateness, timing, or quality of the underlying investigations.

Statistical Analysis

Analyses were descriptive. Continuous variables were summarised using mean and standard deviation, and categorical variables using frequencies and percentages. Wilson score 95% confidence intervals were calculated for principal proportions. Because the objective was to characterise the risk-management profile of the cohort, no causal or between-group hypothesis was tested. Medication frequencies were not interpreted as evidence of adherence, treatment adequacy, or guideline concordance.

Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Research Ethics Committee of Lincoln University College, Malaysia (Approval No. LUC-REC/2024/078). Institutional permission to access anonymised records was granted by Tripoli Medical Centre, Benghazi Medical Centre, and Tajoura Heart Centre. The requirement for written informed consent was waived because the analysis used retrospective, de-identified clinical records.

Results

Participant and Cardiometabolic Profile

The final cohort comprised 200 adults aged 26–85 years, with a mean age of 56.4 ± 12.8 years. Men represented 84.5% of participants. Mean BMI was 27.03 ± 2.31 kg/m²; 81.0% were

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classified as overweight and 8.0% as obese. Hyperlipidaemia was documented in 89.0%, hypertension in 83.0%, diabetes mellitus in 43.0%, and a first- or second-degree family history of coronary artery disease in 52.0% (Table 1).

Table 1. Demographic and cardiometabolic characteristics of the cohort (N = 200)

Characteristic	n or mean ± SD	%
Age, years	56.4 ± 12.8	—
Male sex	169	84.5
Female sex	31	15.5
BMI, kg/m²	27.03 ± 2.31	—
Underweight	3	1.5
Normal weight	19	9.5
Overweight	162	81.0
Obese	16	8.0
Overweight or obese	178	89.0
Hypertension	166	83.0
Diabetes mellitus	86	43.0
Hyperlipidaemia	178	89.0
Family history of CAD	104	52.0

CAD, coronary artery disease; BMI, body mass index.

Lifestyle and Dietary Risk Exposures

Adverse dietary exposures were common. Low fresh-vegetable intake was recorded in 80.0% of participants, high red-meat intake in 86.0%, frequent trans-fat intake in 81.5%, and low omega-3 fatty-acid intake in 84.0%. A sedentary activity pattern was recorded in 78.5%, while none of the source records was classified in the high-activity category. Current smoking was reported by 32.0% and former smoking by 23.5%; therefore, 55.5% had current or previous smoking exposure (Table 2).

Table 2. Lifestyle and dietary risk exposures (N = 200)

Exposure	n	%	95% CI
Low intake of fresh vegetables	160	80.0	73.9–85.0
High intake of red meat	172	86.0	80.5–90.1
Frequent intake of trans fats	163	81.5	75.5–86.3
Low intake of omega-3 fatty acids	168	84.0	78.3–88.4
Sedentary physical-activity pattern	157	78.5	72.3–83.6
Moderate physical-activity pattern	43	21.5	16.4–27.7
High physical-activity pattern	0	0.0	0.0–1.9
Current smoker	64	32.0	25.9–38.8
Former smoker	47	23.5	18.2–29.8

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Exposure	n	%	95% CI
Non-smoker	89	44.5	37.8–51.4
Current or former smoker	111	55.5	48.6–62.2

CI, Wilson score confidence interval.

Subsequent Cardiac Interventions, Medication Use, and Documented Follow-Up Indicators

A subsequent cardiac intervention (after the index coronary assessment) was recorded in 25 participants (12.5%), most commonly percutaneous coronary intervention or stenting (8.0%). Statins were documented in 90.5% and antiplatelet agents in 84.0%; beta-blockers and other cardiovascular medications were recorded in 39.0% and 46.0%, respectively. ECG changes were present in 78.0% of records, while ejection fraction and inflammatory markers were documented in 48.5% and 57.0% (Table 3).

Table 3. Subsequent recorded cardiac interventions, cardiovascular medication use, and documented follow-up indicators (N = 200)

Domain / Category	n	%	95% CI
Any cardiac intervention	25	12.5	8.6–17.8
PCI or stenting	16	8.0	5.0–12.6
CABG	3	1.5	0.5–4.3
TAVI or pacemaker	3	1.5	0.5–4.3
Other intervention	3	1.5	0.5–4.3
Statin	181	90.5	85.6–93.8
Antiplatelet agent	168	84.0	78.3–88.4
Beta-blocker	78	39.0	32.5–45.9
Other cardiovascular medication	92	46.0	39.2–52.9
ECG changes present	156	78.0	71.8–83.2
Ejection fraction documented	97	48.5	41.7–55.4
Inflammatory markers documented	114	57.0	50.1–63.7

Medication categories were not mutually exclusive. PCI, percutaneous coronary intervention; CABG, coronary artery bypass grafting; TAVI, trans catheter aortic valve implantation; ECG, electrocardiogram; CI, Wilson score confidence interval.

Discussion

This multicentre analysis identified a dense concentration of modifiable cardiovascular risks among Libyan adults referred for coronary assessment. Four dietary exposures were recorded in at least four out of five participants, nearly eight out of ten were sedentary, and more than half had current or previous smoking exposure. Cardiometabolic diagnoses were also common, particularly hyperlipidaemia and hypertension. At the same time, statin and antiplatelet use was extensive. The overall pattern therefore reflects the coexistence of substantial documented behavioural and metabolic risk exposures with frequent use of cardiovascular medications in this

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selected referral cohort; however, medication frequency alone cannot establish treatment adequacy, adherence, or quality of clinical management.

The dietary findings are consistent with the broader national context, although definitions and sampling frames differ. In the Libya STEPS survey, 93.9% of adults consumed fewer than five daily servings of fruit and vegetables (WHO, 2023). The present referral cohort used simpler binary dietary categories, but the high frequencies of low vegetable intake, high red-meat consumption, trans-fat exposure, and low omega-3 intake similarly indicate an unfavourable dietary pattern. These factors may contribute to endothelial dysfunction, dyslipidaemia, insulin resistance, and atherosclerotic progression (Jebari-Benslaiman et al., 2022). Because the data were based on clinical documentation rather than validated dietary recall, the findings should guide further assessment rather than quantify nutrient intake.

Sedentary behaviour was recorded in 78.5% of participants, compared with 45.3% insufficient physical activity in the population-based Libya STEPS survey (WHO, 2023). This difference likely reflects the referral-selected cohort and differing definitions, as discussed further below. Nevertheless, the magnitude of inactivity is clinically important. The WHO physical-activity guidelines emphasise that adults should reduce sedentary time and achieve regular moderate- or vigorous-intensity activity appropriate to their health status (Bull et al., 2020). Structured exercise counselling and cardiac rehabilitation referral may therefore be valuable components of care where clinically feasible.

Current smoking was documented in 32.0% of the cohort, and a further 23.5% were former smokers. The national STEPS estimate for current smoking was 21.5%, with a pronounced male predominance (WHO, 2023). The higher proportion likely reflects the same referral and sex-composition factors noted above. Smoking cessation should remain a core intervention because tobacco exposure acts synergistically with hypertension, dyslipidaemia, diabetes, and physical inactivity to amplify cardiovascular risk (Yusuf et al., 2004; Visseren et al., 2021).

The mean BMI of 27.03 kg/m² was close to the national STEPS mean of 27.0 kg/m², but 89.0% of the referral cohort was classified as overweight or obese. Hypertension, hyperlipidaemia, and diabetes mellitus were documented in 83.0%, 89.0%, and 43.0%, respectively. These frequencies greatly exceed population-level measurements because the present cohort consisted of adults already selected for coronary assessment and because the variables reflected clinical diagnoses rather than a single survey measurement. The pattern is nevertheless consistent with local evidence that hypertension, diabetes, and smoking are important contributors to coronary disease among western Libyan patients (Bheleel et al., 2025).

Statins and antiplatelet agents were recorded in 90.5% and 84.0% of participants. Such high use is plausible in a coronary referral cohort and is directionally consistent with contemporary guidance on lipid-lowering and antithrombotic therapy for appropriate patients with established chronic coronary syndromes (Mach et al., 2020; Vrints et al., 2024). However, the dataset did not

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include dose, duration, indication, treatment targets, contraindications, adherence, or bleeding risk. The frequencies therefore describe medication exposure only and cannot establish whether therapy was optimised or appropriate for each individual.

Subsequent cardiac interventions were recorded in 12.5% of participants, most commonly percutaneous coronary intervention or stenting. Follow-up indicators varied in what they capture: ECG changes were present in 78.0% of records, reflecting a clinical finding, whereas ejection fraction and inflammatory markers were documented in 48.5% and 57.0%, reflecting whether that information was available in the record rather than whether results were normal or abnormal. These variables should not be interpreted as direct quality indicators because not every investigation is required for every clinical presentation. They do, however, illustrate uneven availability of functional and laboratory documentation, supporting the value of standardised risk and follow-up templates across referral centres.

Clinically, these findings support systematic assessment of nutrition, physical activity, tobacco exposure, weight, blood pressure, glycaemia, and lipids alongside medication review in coronary referral settings. Structured counselling and medication reconciliation may help address documented residual risk, but their effectiveness in Libyan cardiac services, given local resource and continuity-of-care constraints, requires prospective evaluation (Katoue et al., 2022).

Strengths and Limitations

Strengths of this study include its multicentre design, inclusion of 200 adults from three major cardiac referral centres, use of a structured extraction instrument, and independent double-abstraction of approximately 10% of records by trained reviewers. It also brings together behavioural exposures, cardiometabolic diagnoses, medication classes, interventions, and follow-up indicators in a single clinically relevant profile.

Several limitations require emphasis. Most importantly, this cohort represents adults already selected for clinically indicated coronary assessment at three referral centres, not a general Libyan adult population; all frequencies reported here describe this selected referral cohort and should not be extrapolated to population-level prevalence. The retrospective design also precludes causal inference. The cohort was markedly male-predominant, which limits interpretation across sexes. Dietary, activity, and smoking variables depended on clinical documentation and self-report using a single structured instrument applied at all three centres; however, the underlying clinical documentation practices that fed this instrument were not independently harmonised across sites, and quantitative definitions (for example, gram-per-day thresholds) were not uniform. Medication records did not capture dose, duration, adherence, indication, treatment targets, or contraindications. The intervention variable combined procedures recorded at any point after the index assessment and did not capture their timing, so no time-to-event analysis was possible. Follow-up indicators differed in what they represent — ECG changes denote a clinical finding, whereas ejection-fraction and inflammatory-marker variables denote whether that information was documented — and an absent record should not

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be read as evidence that the underlying investigation or finding was itself absent. Exploratory subgroup description (for example, by sex, age group, diabetes, or hypertension) was not undertaken here and is noted as a direction for future analysis rather than a gap in the present descriptive scope. Finally, the analysis was intentionally descriptive and did not link risk or treatment variables to longitudinal cardiovascular outcomes.

Conclusion

The coexistence of adverse dietary exposures, sedentary behaviour, smoking history, excess weight, hypertension, hyperlipidaemia, and diabetes demonstrates a substantial documented cardiovascular risk burden among this selected cohort of Libyan adults referred for coronary assessment. Statin and antiplatelet use was frequently documented, while modifiable lifestyle risks remained prominent and follow-up documentation was variable. These findings support prospective evaluation of integrated lifestyle, medication, and monitoring pathways across Libyan cardiac centres. They describe a selected clinical cohort and should not be interpreted as national prevalence estimates, evidence of treatment appropriateness, or causal relationships.

Declarations

Ethics Approval and Consent to Participate

Ethical approval was obtained from the Research Ethics Committee of Lincoln University College, Malaysia (Approval No. LUC-REC/2024/078). Institutional permissions were obtained from Tripoli Medical Centre, Benghazi Medical Centre, and Tajoura Heart Centre. The requirement for written informed consent was waived because retrospective, de-identified records were used.

Consent for Publication

Not applicable. The manuscript contains no identifiable individual data, images, or case details.

Data Availability

The de-identified dataset is not publicly available because it derives from clinical records. Access may be considered by the corresponding author upon reasonable request and subject to ethical and institutional approval.

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Conflicts of Interest

The authors declare no conflict of interest.

Author Contributions

Y.A.M.W.: conceptualisation, data curation, formal analysis, interpretation, and original draft preparation. E.M.N.A., L.S., and M.S.K.: supervision, methodological review, interpretation, and critical revision of the manuscript. All authors approved the final version and agree to be accountable for the work.

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