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Original Article

Multidomain Lifestyle Factors and a Preliminary Composite Lifestyle Score in Patients with Acute Coronary Syndrome: A Pilot Case-Control Study

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ABSTRACT

In recent years, the incidence of Acute Coronary Syndrome (ACS) has been increasing worldwide. Although modified risk factors are well established, the combined contribution of lifestyle factors to ACS has not been extensively studied. This study aimed to examine multidomain lifestyle factors associated with ACS by developing a preliminary lifestyle composite. A pilot case-control study was conducted using data from 55 ACS cases and 55 healthy controls. Lifestyle factors were assessed using a questionnaire including the Pittsburgh Sleep Quality Index (PSQI), Depression Anxiety Stress Scales (DASS-21), Food Habits Questionnaire (FHQ), Night Eating Diagnostic Questionnaire (NEDQ), and the Global Physical Activity Questionnaire (GPAQ). The hypothesis was analyzed using a bivariate test, followed by binary logistic regression. Bivariate analysis identified educational level (p=0.019), comorbidities (p<0.001), body mass index (p=0.037), stress level (p=0.001), sleep quality (p=0.004), night eating patterns (p<0.001), fat consumption, and physical activity (p<0.000) associated with ACS incidence. A preliminary composite lifestyle score was constructed and was strongly associated with ACS incidence (p<0.001). Multivariable logistic regression further confirmed that preliminary composite lifestyle risk, comorbidities, age, and BMI independently predicted ACS occurrence, with comorbidities (OR=16.69; 95% CI:4.05-68.67) and lifestyle risk (Wald X^2=17.2), followed by BMI (OR=3.15; 95% CI:1.21-8.22) and age (OR=2.82; 95% CI:1.46-5.45). The preliminary composite lifestyle score demonstrated a strong association with ACS Status, and warrants validation in larger, prospective cohorts before clinical application.

Keywords: *Acute coronary syndrome, lifestyle, comorbid, age, body mass index, composite score*

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INTRODUCTION

Cardiovascular disease (CVD) is one of the major health problems worldwide and causes approximately 80 % of mortality in low- and middle-income countries (1). Acute Coronary Syndrome (ACS) is one of the most common forms of CVD and has significant morbidity, besides high-level mortality rate (2). According to the American Heart Association (AHA), it accounts for more than 800,000 hospitalizations each year (3). Numerous studies have concluded that unhealthy lifestyles are associated with ACS(4). This evidence is reinforced by the fact that most people worldwide adopt unhealthy lifestyles(5).

Growing evidence demonstrates that lifestyle factors interact with one another as risk factors for ACS. However, most studies only examined these factors separately. 17.8 % of the adult population in Italy experiences poor sleep quality, including short sleep duration, difficulty falling asleep, and staying asleep (6–8). Chronic physiological stress was associated with myocardial ischemia (9). In the US, a study reported that 47% of adults had poor diet quality (10). Similar results were found in Southeast Asia, where two-thirds (62.6%) of adults consumed sweet beverages and over three-quarters consumed unhealthy/ ultra-processed foods (76.8%) (11). Dietary habits influence various risk factors for cardiovascular disease, including lipoprotein levels, blood pressure, glucose levels, and weight gain. Recent studies showed that food high in fat and mealtime preference increased the risk of death from ACS (12). A report stated that the majority of ACS patients do not engage in physical activity. This is because a lack of physical activity decreases endothelial function, which can increase the occurrence of ACS (13,14). In addition, someone who is inactive will experience increased atherosclerotic plaque and thrombus formation, which can cause ACS (15).

These lifestyle factors often coexist and may interact with one another, rather than occurring independently. However, the combined or multidomain association between lifestyle factors and ACS is insufficiently understood (16). Furthermore, most studies were conducted in developed countries and in countries with strong national health surveillance systems. There is insufficient community-level population data in Indonesia. Although early detection of ACS risk should ideally be performed at the primary level of health services, there is a lack of longitudinal or even cross-sectional studies based on primary services such as Pusat Kesehatan Masyarakat (Puskesmas) (17). Furthermore, psychosocial problems and comprehensive lifestyle profiles are commonly neglected in primary care in Indonesia. The aim of the study was to investigate the association between lifestyle-related factors and ACS status through a pilot study. Thus, this study could later be developed into a preliminary composite lifestyle score to support early screening and preventive interventions in primary care settings, such as Puskesmas in Indonesia.

METHOD

Study Design

This observational study employed a case-control design to investigate the association between multidomain lifestyle and psychosocial factors and ACS.

Setting

This study was conducted from May to December 2025 at Karsa Husada Hospital in Batu City, East Java Province, Indonesia.

Sample/Participants

The population of this study was ACS patients in Karsa Husada Hospital. Participants were recruited using non-probability sampling with a convenience method (18). The inclusion criteria for the case group in this study were as follows: (a) ACS patients confirmed from medical records, (b) > 18 years old, and (c) agreed to be research respondents. The exclusion criteria for the case group included: (a) dropouts during the study, (b) consumption of diet pills or laxatives, intermittent fasting diets, (c) having an inherited sleep disorder, (d) physical disability, and (e) inability to read and write. The inclusion criteria in the control group were: (a) not having experienced ACS, (b) agreed to be respondents, (c) age > 18 years old, and (d) healthy status. The participant number was calculated using the Lemeshow formula. Lifestyle-related factors such as physical inactivity, poor diet, and stress have been consistently associated with increased risk of ACS, with reported odds ratios (OR) ranging from approximately 1.3 to 4.5, depending on the specific exposure and population studied. Based on these findings, an OR of 2.0 was conservatively assumed in this study. The prevalence of exposure in the control group was set at 30%, reflecting the reported variability of lifestyle risk factors in the general population, and ensuring a conservative sample size estimation. According to this formula, there were 100 cases and 100 controls. However, since this was a pilot study, the sample size was set at 110, including 55 cases of ACS and 55 healthy controls, matched by sex, with a 1:1 case-to-control ratio.

Data Collection

The data were collected at Karsa Husada Hospital from May to December 2025, and included sociodemographic characteristics, stress level assessment, sleep quality assessment, physical activity evaluation, fat screener, and night eating time test. Sociodemographic characteristics, including age, sex, educational and occupational profile, were assessed from medical records.

Assessment of Stress Level: Stress level was assessed using the DASS-21 questionnaire, a self-report 4-point Likert-type measure of three dimensions of mental health: depression, anxiety, and stress. The DASS-21 has excellent psychometric properties in older adults. Individuals with a DASS-21 stress score of 15 or higher were categorized as being under high stress (19).

Assessment of Sleep Quality: Sleep quality and disturbances were assessed using the PSQI questionnaire, comprising 19 individual items designed to assess seven components of sleep quality, including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. The score for each component is equally weighted on a 0–3 scale, with a higher score indicating poorer sleep quality. The total score of the PSQI ranges from 0 to 21, and poor sleep quality was defined as a score >5 (20).

Physical Activity Evaluation: Physical activity was measured using the Global Physical Activity Questionnaire (GPAQ). Physical activity is undertaken in

three domains: activity at work, travel to and from places, and recreational activities. The intensity of physical activity is commonly expressed in METs. The total MET-min score is computed as the sum of all MET-min per week from Moderate to Vigorous Physical Activity (MVPA) performed in work, commuting, and recreation (21).

Fat Screener and Night Eating Time Test: Eating habits and meal times were each measured using the Food Habits Questionnaire (FHQ) and the Night Eating Diagnostic Questionnaire (NEDQ). Both questionnaires have been validated and show strong validity (22).

Data Analysis

The data will be presented using descriptive statistics for each variable studied. This analysis aimed to describe the frequency distribution of various variables, including participant profiles (age, gender, medical history, occupation, and income), meal times, eating habits, physical activity levels, nutritional status, sleep quality, stress levels, and the ACS status.

This was a pilot study with a small sample size and potential conceptual interrelationships between lifestyle domains based on literature. A composite lifestyle risk score was planned at the analysis design stage as the primary approach to capture the simultaneous synergistic effects of multiple behavioral domains, thereby anticipating limitations in statistical power and the risk of multicollinearity in regression models using individual predictors. Individual bivariate analyses using Fisher or Chi-Square were conducted transparently during the initial phase as a confirmatory step, rather than as a search for an alternative approach.

To capture the synergistic, multidomain nature of lifestyle-related CVD risk, a composite lifestyle risk score was constructed by aggregating scores across five domains: stress, sleep quality, night eating pattern, dietary fat consumption, and physical activity. Each domain was scored ordinally according to categories defined by its respective validated instrument. This scoring approach resulted in implicit differential weighting, rather than an empirically derived weighting scheme based on regression coefficients or effect size. Subsequently, the cut-off values used to categorize participants into high, medium, and low lifestyle risk groups were defined a priori, based on the total possible range of each lifestyle parameter in the composite score, which was later divided into approximately three-width bands

The hypothesis test using composite score was performed using bivariate analysis, followed by binary logistic regression to analyse factors influencing the ACS status, and made model predictions based on the predictors. Model significance testing was carried out using the Omnibus Test of Model Coefficients, and model fit evaluation used to evaluate the Hosmer-Lemeshow value. Nagelkerke R^2 showed what proportion of the variability of the dependent variable ACS can be explained by the independent variables (diet, physical activity, blood pressure, etc.). Next, the AOR value was evaluated based on the significance value received for each variable ($p < 0.05$), and conclusions were made regarding the function for each variable, either protective or triggering. All the analysis was carried out using SPSS version 26.0.

Ethical Consideration

This study has received approval from the ethics committee of Karsa Husada Hospital with registration number 020/743/102.13/2024. All participants included were provided informed consent after being briefed on the study's objectives, procedures, potential risks, and benefits. Confidentiality and anonymity were ensured, and participants were informed of their right to withdraw at any stage of the study.

RESULTS

Demographic profile and baseline clinical characteristics of study participants

Patients diagnosed by internal medicine specialists at Karsa Husada Hospital between May and September 2025 were included as potential participants in the study. A total of 154 patients were initially assessed for eligibility. Of these, 34 participants were excluded for failing to meet the predefined eligibility criteria. The remaining eligible participants were considered for matching based on sex. During the matching process, participants for whom an appropriate match could not be identified were excluded. The final matched sample consisted of 110 participants, including 55 cases and 55 controls.

The proportions of men and women were relatively balanced between the case and control groups. The older age group (≥46 years) predominated in the case group, while those aged <45 years were more prevalent in the control group (45.57%). Most ACS patients were unemployed (33.3%). The majority of ACS cases had a secondary education level (46.7%). Interestingly, most ACS patients had no family history of disease (70.0%), while 68.3% had comorbid hypertension (HT), followed by type 2 diabetes mellitus (T2DM) and dyslipidemia.

Table 1. Demographic and clinical profile of the participants (n=110)

Variable	Participant			
	ACS Case (n=55)		Control (n=55)	
	n	%	n	%
Gender				
Female	27	49.1	27	49.1
Male	28	50.9	28	50.9
Age				
<36	0	0	10	18.2
36–45	2	3.6	16	29.1
46–55	25	45.5	18	32.7
56–65	19	34.5	8	14.5
>65	9	16.4	3	5.5
Occupation				
Civil Servant	6	10.9	15	27.3
Private Employee	9	16.4	7	12.7
Entrepreneur	9	16.4	7	12.7
Farmer	11	20	13	23.6
Laborer	3	5.5	4	7.3
Unemployed	17	30.9	9	16.4
Educational Background				
Basic (Elementary-Junior	21	38.2		20
High School)	28	50.9	11	49.1
Intermediate (Senior	6	10.9	27	30.9
High School)			17	
Higher				

Table 1. Demographic and clinical profile of the participants (n=110)

Variable	Participant			
	ACS Case (n=55)		Control (n=55)	
	n	%	n	%
Educational Background				
Basic (Elementary-Junior High School)	21	38.2	11	20
Intermediate (Senior High School)	28	50.9	27	49.1
Higher	6	10.9	17	30.9
Family Medical History				
None	37	67.3	34	61.8
HT	6	10.9	7	12.7
DMT2	4	7.3	5	9.1
HT+DMT2	2	3.6	3	5.5
HT+CHD	1	1.8	0	0.0
DMT2+CHD	1	1.8	0	0.0
CHD	4	7.3	6	10.9
Smoking History				
Non-Smoker	40	72.7	42	76.4
Smoker	15	27.3	13	23.6
Comorbidities				
None	14	25.5	46	83.6
HT	16	29.1	3	5.5
DMT2	7	12.7	1	1.8
Hyperlipidemia	1	1.8	1	1.8
HT+DMT2	6	10.9	2	3.6
HT+Hyperlipidemia	6	10.9	1	1.8
HT+Hyperuricemia	1	1.8	0	0.0
DMT2+CKD	2	3.6	0	0.0
HT+DMT2+Hypercholesterolemia	2	3.6	1	1.8

Note: ACS = Acute Coronary Syndrome, CHD = Coronary Heart Disease, HT = hypertension, DMT2 = diabetes mellitus type 2, CKD = chronic kidney disease

Bivariate analysis of lifestyle factors and ACS incidence

To provide a clearer understanding of how behavioral patterns contribute to cardiovascular events, we examined several lifestyle parameters in relation to ACS. Table 2 below presented the association between lifestyle factors and ACS status.

Table 2. Relationship between lifestyle factors and ACS status

Lifestyle Parameter	ACS		P-value
	Case	Control	
Gender			
Female	30	26	0.448
Male	25	29	
Age			
<36	0	10	0.000**
36–45	1	16	
46–55	25	18	
56–65	20	8	
>65	9	3	
Occupation			
Civil Servant	6	15	0.211
Private Employee	9	7	
Entrepreneur	9	7	
Farmer	11	13	
Laborer	3	4	
Unemployed	17	9	

Table 2. Relationship between lifestyle factors and ACS status

Lifestyle Parameter	ACS		P-value
	Case	Control	
Occupation			
Education			
Basic	21	11	0.019*
Intermediate	28	27	
Higher	6	17	
Smoking History			
Smoking	16	12	0.512
No Smoking	39	43	
Comorbidities			
Yes	41	9	0.000**
No	14	46	
BMI			
Obesity	11	5	0.037*
Overweight	23	16	
Normal	21	34	
Stress Level			
Not Stress	30	49	0.001**
Mild	2	2	
Moderate	6	2	
Severe	11	1	
Extreme	6	1	
Sleep Quality			
Good	31	46	0.004*
Poor	29	14	
NEDQ			
Non-Night Eater	11	47	0.000**
Mild Night Eater	17	5	
Moderate Night Eater	16	1	
Full Night Eater	11	2	
FHQ			
Small Fat Consumption	1	6	0.000**
Medium Fat Consumption	8	40	
Large Fat Consumption	46	9	
PA			
Low PA	47	12	0.000**
Moderate PA	3	32	
High PA	5	11	

Note: * = p< 0.05, ** = p<0,001, ACS = Acute Coronary Syndrome, BMI = Body Mass Index, NEDQ = Night Eating Diagnostic Questionnaire, FHQ = Food Habits Questionnaire, PA = Physical Activity

Model prediction of ACS based on lifestyle factors

Assessment of the association between lifestyle factors and ACS state after controlling for variables used a binary logistic regression test. Although the omnibus test indicated that the model was statistically significant, none of the individual predictors showed a significant effect in the tests. This may suggest multicollinearity or overlapping effects among predictors, particularly among lifestyle-related variables, which might attenuate the individual contributions in the multivariable model. Therefore, because cardiometabolic risk arises from the synergistic interaction of multiple behavioral exposures rather than from isolated factors, the next step in this study was to justify using an aggregated lifestyle risk construct, as shown in Table 3.

After designing the construct, the Chi-Square test was used to analyze this composite score with ACS, which was displayed in Table 4.

Table 3. Preliminary Composite Lifestyle Factor

Preliminary Composite Lifestyle Score	Score		
Stress	Not + Mild (3,4)	Moderate (2)	Severe + Extreme (1)
Sleep	Good (2)	Poor (1)	Poor (0)
NEDQ	Non-Night Eater (3)	Mild Night Eater (2)	Moderate-Full (1), Night Eater (0)
FHQ	Small Fat (2)	Medium Fat (1)	Large Fat (0)
PA	High (2)	Moderate (1)	Low (0)

Note: NEDQ = Night Eating Diagnostic Questionnaire, FHQ = Food Habits Questionnaire, PA = Physical Activity, High Risk ≤2, Medium Risk ≤7, Low Risk > 7

Table 4. Demographic and clinical profile of the participant (n=110)

Preliminary Composite Lifestyle Score	ACS status		Total	P-value
	Yes	No		
High Risk	3	0	3	
Medium Risk	33	4	37	0.000**
Low Risk	19	51	70	
Total	55	55	110	

Note: *, P<0.05; **P<0.001, ACS = Acute Coronary Syndrome

Goodness of Fit (GFI) was used to assess how well the statistical model explained the data. Because the value was far below 1 (0.108), this indicated under dispersion (data variance was smaller than predicted by the model), but the model was generally still usable. The Omnibus Test was the most crucial in determining whether the overall model was meaningful. Since the p-value is 0.000 ($p < 0.05$), the model was statistically significant. This means that the combination of independent variables (age, BMI, and comorbidities) together had a significant effect on the dependent variable (ACS status). This model was significantly better than a model that uses no predictors.

Tests of Model Effects indicated whether a variable has a significant independent effect on the model. All variables in the model (lifestyle, age, combined BMI, and comorbidities) were significant ($p < 0.05$). This meant that the four variables individually had a significant effect on the risk or occurrence of an ACS incident. Based on the Parameter Estimates table, the composite lifestyle factor variable showed a significant effect on ACS status ($p < 0.05$) after controlling for the covariate variables (age, BMI, and comorbidities) in the regression model.

Based on the Wald Chi-Square values, lifestyle variables (17.2) and comorbidities (15.15) had the largest contribution compared to other variables. All confounding variables had positive B coefficients, indicating a unidirectional relationship. Each one-unit increase in age would increase the ACS score by 2.8 ($B = 0.110$, $p = 0.000$). Each 1 unit increase in BMI would increase the ACS score by 3.15. This indicated that higher body weight was associated with a higher risk ($B = 0.097$, $p = 0.023$). The presence or increase in comorbid conditions had the greatest impact among other continuous variables, namely increasing the ACS Incidence score by 16 times ($B = 0.351$, $p = 0.000$): there was a clear risk gradient related to lifestyle. Individuals with a severely bad lifestyle had a significantly higher risk of ACS compared to those with a moderate or good lifestyle. These findings remained consistent even after accounting for confounding variables such as age, BMI, and comorbidities in the statistical model.

DISCUSSION

Based on the findings, physical activity is the strongest parameter associated with ACS status. According to Franklin and Jae, engaging in regular physical exercise improves cardiorespiratory fitness, which is associated with the risk of CVD, including hypertension and ACS (23,24). Additionally, regular exercise can lower systemic vascular resistance, which in turn may lower blood pressure, increase nitric oxide release, a vasodilator, and improve endothelial function, thereby inhibiting plaque

Table 5. Parameters Estimate

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			Exp(B)	95% Wald Confidence Interval for Exp(B)	
			Lower	Upper	Wald Chi-Square	df	Sig.		Lower	Upper
(Intercept)	-7.94	1.91	-11.69	-4.19	17.2	1	.000	.000	8.351E-6	.015
Low-Risk Lifestyle	-22.27	39982.05	-78385.65	78341.1	.000	1	1.000	2.121E-10	.000	.[a]
Medium-Risk Lifestyle	-3.53	.871	-5.24	-1.825	16.439	1	.000	.029	.005	.161
High-Risk Lifestyle	0[b]	.	.	.	.	.	.	1	.	.
Comorbid	2.815	.7232	1.397	4.232	15.150	1	.000	16.690	4.045	68.870
Age	1.035	.3370	.375	1.696	9.439	1	.002	2.816	1.455	5.451
BMI	1.148	.4889	.190	2.107	5.516	1	.019	3.153	1.209	8.220

Note: *, P<0.05; **P<0.001, B = B coefficient, df = degrees of freedom, Sig = significance, Exp(B) = exponentiated logistic regression coefficient

formation, all of which are associated with lower ACS status (25). Moreover, physical activity is also associated with a decreased risk of cardiovascular events in patients diagnosed with ACS (26). Another report showed that the level of physical activity determines the risk of developing major adverse cardiovascular events (MACE) in ACS. This study confirms that changes in dietary habits play an important role in the incidence of ACS. Eating habits were measured using the FHQ, focusing on four behaviors: avoiding high-fat ingredients and cooking methods, choosing low-fat specialized products, replacing high-fat foods with low-fat alternatives, and modifying fatty foods. A diet high in saturated fats, cholesterol, sugar, and salt, along with processed and fast foods, correlates with increased inflammation and an increased risk of heart disease. Another study showed that unhealthy eating habits, such as skipping breakfast, were associated with elevated lipid levels, atherosclerosis, and an increased risk of ACS (27,28). Stress and sleep are also associated with ACS. The sleep duration and sleep quality show a dose-dependent relationship with coronary events (8). Mental stress is an emerging risk and prognostic factor for coronary artery disease and stroke and is associated with an increased incidence of cardiovascular events (29–31).

Overall, the findings provide initial evidence that a multidomain lifestyle approach is associated with ACS more strongly than a single-domain approach. These findings are consistent with evidence from a large population-based prospective cohort study showing that adherence to a favorable lifestyle, characterized by non-smoking, absence of obesity, regular physical activity, and a healthy diet, was associated with a 44% lower risk of ACS compared with an unfavorable lifestyle (32). Similarly, an evaluation of a combined lifestyle score in a US population by Guasch-Ferré et al. (2022) found that having six versus zero low-risk factors on a healthy lifestyle score (including sleep duration) was associated with a hazard ratio of 0.17 for CVD and 0.14 for coronary heart disease (CHD), with approximately 66–67% of CVD and CHD cases attributable to non-adherence to the combined healthy lifestyle (7). The consistency of findings across these studies reinforces the biological and epidemiological plausibility of the current results: the protective effect of lifestyle on acute coronary events appears to be clearly graded according to the cumulative number of risk domains, rather than operating via a single threshold

However, this study has certain limitations. Since the composite lifestyle risk score was constructed using unweighted, instrument-derived ordinal categories rather than empirically weighted coefficients, the relative contribution of each domain to overall risk should therefore be interpreted with caution. The cut-off points for composite lifestyle risk categories were predefined based on the theoretical range of the validated scoring instrument rather than empirically validated thresholds, such as ROC analysis. The composite is face-valid, not statistically valid. Future studies with larger samples should establish empirically derived, and ideally ROC-optimized, cut-off values for this composite lifestyle risk score, prior to use in primary care health services for screening. Additionally, there was recall bias due to the retrospective nature of the data, as the parameters were based on participants' past habits. Technical issues occurred in the logistic regression results due to perfect prediction, were observed based on the significance value. This means that it is highly likely that none of the respondents with a good lifestyle experienced ACS. This is a pilot study with limited participant recruitment; therefore, the findings cannot be generalized beyond this study.

In conclusion, lifestyle factors cannot be considered in isolation; they interact with one another. Together, comorbidities, age, BMI, and the composite lifestyle factor score, including physical activity, dietary pattern, stress, and sleep, are associated with the ACS status. The composite lifestyle risk score developed in this study is a preliminary instrument; its scoring scheme and risk categorizations (High, Medium, Low) were established based on standard categories from validated instruments and theoretical score ranges, rather than on empirical weighting or external validation methods such as ROC analysis. Consequently, while these findings offer initial evidence supporting a multidomain approach to assessing lifestyle-related ACS risk, the composite score cannot yet be recommended as a ready-to-use clinical screening tool in primary care settings. It requires further validation using larger, representative samples—including reliability testing, empirical data-based weighting, and cut-off validation via ROC analysis or cross-validation approaches. Further studies employing a prospective design and larger sample sizes are needed to confirm these findings and to refine the composite lifestyle risk score into an empirically validated screening tool. This would enable its reliable application in the early detection and prevention of ACS within primary healthcare facilities, such as Community Health Centers (Puskesmas) in Indonesia.

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AUTHOR CONTRIBUTIONS

ER (Conceptualization, Writing, Review and Editing, Project Administration, Supervision, Funding Acquisition).

RR (Methodology, Writing, Review and Editing, Supervision, Funding Acquisition).

LSK (Methodology, Writing, Review and Editing).

RZN, MRAD, FU, URM, IHR (Data Collection, Data Curation).

IWS (Data Collection, Data Curation, Supervision).

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest

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REFERENCES

1. Di Cesare M, McGhie DV, Perel P, Mwangi J, Taylor S, Pervan B, et al. *The Heart of the World. Glob Heart*. 2024;19(1). doi:10.5334/gh.1288 PubMed PMID: 38273998.
2. Tessema TB, Ahmed A, Adem HA, Firdisa D, Abebe T, Mossie Y, et al. *Treatment outcome of acute coronary syndrome and associated factors among patients admitted to public hospitals in Harari Regional State, Eastern Ethiopia: a retrospective cross-sectional study*. BMJ Open . 2025 Nov 29;15(11). doi:10.1136/bmjopen-2025-105208 PubMed PMID: 41320219.
3. Palaniappan LP, Allen NB, Almarzooq ZI, Anderson CAM, Arora P, Avery CL, et al. 2026 *Heart Disease and Stroke Statistics: A Report of US and Global Data From the American Heart Association*. Circulation. Lippincott Williams and Wilkins; 2026. doi:10.1161/CIR.0000000000001412 PubMed PMID: 41562125.
4. Szczepańska E, Białek-Dratwa A, Filipów K, Kowalski O. *Lifestyle and the risk of acute coronary event: a retrospective study of patients after myocardial infarction*. Front Nutr. 2023;10. doi:10.3389/fnut.2023.1203841
5. Efa YT, Roder D, Shi Z, Li M. *Clustering Patterns of Unhealthy Lifestyle Behaviours Among Adolescents: A Multilevel Analysis of a Nationally Representative School-Based Survey from 73 Countries*. Nutrients . 2025 Feb 1;17(4). doi:10.3390/nu17040609 PubMed PMID: 40004937.
6. Ausserhofer D, Piccoliori G, Engl A, Marino P, Barbieri V, Lombardo S, et al. *Sleep Problems and Sleep Quality in the General Adult Population Living in South Tyrol (Italy): A Cross-Sectional Survey Study*. Clocks Sleep. 2025 Jun 1;7(2). doi:10.3390/clockssleep7020023
7. Guasch-Ferré M, Li Y, Bhupathiraju SN, Huang T, Drouin-Chartier JP, Manson JAE, et al. *Healthy Lifestyle Score Including Sleep Duration and Cardiovascular Disease Risk*. Am J Prev Med. 2022 Jul 1;63(1):33–42. doi:10.1016/j.amepre.2022.01.027 PubMed PMID: 35361505.
8. Shi Q, Gao Y, Zhang Z, Shi Z, Yu H, Zhang T, et al. *Correlation of Sleep Duration and Sleep Quality With Coronary Atherosclerotic Plaque Vulnerability: An Optical Coherence Tomography Study*. Rev Cardiovasc Med. 2025 Nov 1;26(11). doi:10.31083/RCM41098
9. Moazzami K, Garcia M, Sullivan S, Lewis TT, Bremner JD, Razavi AC, et al. *Association Between Symptoms of Chronic Psychological Distress and Myocardial Ischemia Induced by Mental Stress in Patients With Coronary Artery Disease*. J Am Heart Assoc. 2023 Nov 7;12(21). doi:10.1161/JAHA.123.030305 PubMed PMID: 37929719.
10. Pries AM, Feeley A, Kupka R. *Diet Quality Among Older Adolescent Boys and Girls in the Southeast Asia Region*. Matern Child Nutr. 2025 Apr 1;21(2). doi:10.1111/mcn.13774 PubMed PMID: 39632483.
11. Silveira EA, Mendonça CR, Delpino FM, Elias Souza GV, Pereira de Souza Rosa L, de Oliveira C, et al. *Sedentary behavior, physical inactivity, abdominal obesity and obesity in adults and older adults: A systematic review and meta-analysis*. Clin Nutr ESPEN. 2022 Aug 1;50:63–73. doi:10.1016/j.clnesp.2022.06.001 PubMed PMID: 35871953.
12. Bhusal B. *Poor Diet Leading to the Increasing Risk of Atherosclerosis in the World*. J Cardiol Cardiovasc Med. 2024 Sep 3;9(3):142–7. doi:10.29328/journal.jccm.1001195
13. Perry AS, Dooley EE, Master H, Spartano NL, Brittain EL, Pettee Gabriel K. *Physical Activity Over the Lifecourse and Cardiovascular Disease*. Circ Res. 2023 Jun 9;132(12):1725–40. doi:10.1161/CIRCRESAHA.123.322121 PubMed PMID: 37289900.
14. Winzer EB, Woitek F, Linke A. *Physical activity in the prevention and treatment of coronary artery disease. Journal of the American Heart Association*. American Heart Association Inc.; 2018. doi:10.1161/JAHA.117.007725 PubMed PMID: 29437600.
15. Matthias AT, de Silva DKN, Indrakumar J, Gunatilake SB. *Physical activity levels of patients prior to acute coronary syndrome – Experience at a tertiary care hospital in Sri Lanka*. Indian Heart J. 2018 May 1;70(3):350–2. doi:10.1016/j.ihj.2017.08.020 PubMed PMID: 29961449.
16. Tokarewicz J, Kobylińska J, Krajewska-Kułak E, Jankowiak B, Klimaszewska K, Święczkowski M, et al. *Lifestyle Habits and Comorbidities as Determinants of Quality of Life in Coronary Artery Disease: A Single-Center Prospective Study*. J Clin Med. 2026 Mar 1;15(6). doi:10.3390/jcm15062384
17. Wouters LTCM, Zwart DLM, Erkelens DCA, Adriaansen EJM, Den Ruijter HM, De Groot E, et al. *Development and validation of a prediction rule for patients suspected of acute coronary syndrome in primary care: a cross-sectional study*. BMJ Open. 2022 Oct 5;12(10). doi:10.1136/bmjopen-2022-064402 PubMed PMID: 36198462.
18. Fahim NK, Negida A, Fahim AK. *Sample Size Calculation Guide - Part 3: How to Calculate the Sample Size for an Independent Case-control Study*. Adv J Emerg Med. 2019;3(2):e20. doi:10.22114/AJEM.v0i0.138 PubMed PMID: 31172131.
19. Marijanović I, Kraljević M, Buhovac T, Cerić T, Abazović AM, Alidžanović J, et al. *Use of the depression, anxiety and stress scale (DASS-21) questionnaire to assess levels of depression, anxiety, and stress in healthcare and administrative staff in 5 oncology institutions in Bosnia and Herzegovina during the 2020 COVID-19 pandemic*. Medical Science Monitor. 2021;27. doi:10.12659/MSM.930812 PubMed PMID: 33867520.
20. Farah NMF, Yee TS, Rasdi HFM. *Self-reported sleep quality using the malay version of the pittsburgh sleep quality index (PSQI-M) in Malaysian adults*. Int J Environ Res Public Health. 2019 Dec 1;16(23). doi:10.3390/ijerph16234750 PubMed PMID: 31783607.

21. Mumu SJ, Ali L, Barnett A, Merom D. *Validity of the global physical activity questionnaire (GPAQ) in Bangladesh. BMC Public Health*. 2017;17(1). doi:10.1186/s12889-017-4666-0 PubMed PMID: 28797237.

22. Nolan LJ, Geliebter A. *Factor structure of the night eating diagnostic questionnaire (nedq) and an evaluation of the diagnostic criteria of the night eating syndrome*. J Eat Disord. 2019 Nov 8;7(1). doi:10.1186/s40337-019-0268-9

23. Franklin BA, Jae SY. *Physical Activity, Cardiorespiratory Fitness and Atherosclerotic Cardiovascular Disease: Part 1*. Pulse. 2024 Sep 30;12(1):113–25. doi:10.1159/000541165

24. Rachmawati E, Riskiyah, Novindra QA, Syarifah NA, Aisy NR. *Association between lifestyle factors and hypertension control in Indonesian primary healthcare settings: A cross-sectional study*. Malaysian Family Physician. 2024;19. doi:10.51866/oa.409 PubMed PMID: 39011294.

25. Smuder A, Coury Pedrosa R, Luigi Bragazzi N, Zhang QY, P-x L, Y-s L, et al. *Daily exercise improves the long-term prognosis of patients with acute coronary syndrome*.

26. Acosta S, Johansson A, Drake I. *Diet and lifestyle factors and risk of atherosclerotic cardiovascular disease—a prospective cohort study*. Nutrients. 2021 Nov 1;13(11). doi:10.3390/nu13113822 PubMed PMID: 34836078.

27. Basdeki ED, Koumi K, Tsirimiagkou C, Argyris A, Chrysostomou S, Sfikakis PP, et al. Late-Night Overeating or *Low-Quality Food Choices Late at Night Are Associated with Subclinical Vascular Damage in Patients at Increased Cardiovascular Risk*. Nutrients. 2022 Feb 1;14(3). doi:10.3390/nu14030470 PubMed PMID: 35276835.

28. Rong S, Snetselaar LG, Xu G, Sun Y, Liu B, Wallace RB, et al. *Association of Skipping Breakfast With Cardiovascular and All-Cause Mortality*. J Am Coll Cardiol. 2019 Apr 30;73(16):2025–32. doi:10.1016/j.jacc.2019.01.065 PubMed PMID: 31023424.

29. Vancheri F, Longo G, Vancheri E, Henein MY. *Mental Stress and Cardiovascular Health—Part I*. Journal of Clinical Medicine. MDPI; 2022. doi:10.3390/jcm11123353

30. Murali I. *Is mental stress a risk factor of acute coronary syndrome? – A case–control study*. Natl J Physiol Pharm Pharmacol. 2022;(0):1. doi:10.5455/njppp.2023.13.11560202212122022

31. Wan-Nor-Asyikeen WA, Siti-Azrin AH, Sulong ZR, Fauzi MH. *Stress in Acute Coronary Syndrome: A Cross-sectional Study in Kelantan and Terengganu, Malaysia*. Zahedan Journal of Research in Medical Sciences. 2023 Aug 13;25(3). doi:10.5812/zjrms-122023

32. Dimovski K, Orho-Melander M, Drake I. *A favorable lifestyle lowers the risk of coronary artery disease consistently across strata of non-modifiable risk factors in a population-based cohort*. BMC Public Health. 2019 Nov 27;19(1). doi:10.1186/s12889-019-7948-x PubMed PMID: 31775698.