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Acute coronary syndrome in young (≤45 years) patients: a multi-centre observational study

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Introduction: Acute coronary syndrome (ACS) in young individuals (≤45 years) is increasingly recognized as a significant health concern, yet research in this demographic remains limited, particularly within the Palestinian context. This study aims to bridge this gap by comprehensively investigating the clinical characteristics, age-specific profiles, gender disparities, treatment modalities, and angiographic patterns of ACS in young patients compared to their older counterparts.

Materials and methods: A multi-centre observational study was conducted, enroling 468 participants aged 18–55 diagnosed with ACS and admitted to three prominent Palestinian hospitals. Data were collected from medical records, and statistical analysis was performed to assess demographic characteristics, clinical presentations, risk factors, treatment strategies, and outcomes.

Results: The majority of participants were male (87%), with a higher proportion in the older age group (>45 years). Clinical presentations varied, with non-ST segment elevation myocardial infarction (NSTEMI) being the most common diagnosis (48%). Risk factors such as smoking, hypertension, and diabetes were prevalent, with notable gender and age-specific differences. Percutaneous coronary intervention (PCI) was the predominant treatment strategy (83%), with consistent medication use across age groups.

Conclusion: ACS in young patients poses a significant public health challenge in Palestine, necessitating tailored preventive strategies and comprehensive management approaches. Understanding the unique demographic and clinical characteristics of young ACS patients is crucial for informing targeted interventions and policies aimed at reducing the burden of cardiovascular disease in this population. These findings contribute valuable insights to the existing literature and underscore the importance of further research in this area to improve outcomes and mitigate the impact of ACS in young individuals globally.

Keywords: ACS, acute coronary syndrome, Palestine, young adults

Introduction

Acute coronary syndrome (ACS) is a prevalent manifestation of coronary artery disease (CAD), encompassing unstable angina, non-ST elevation myocardial infarction (NSTEMI), and ST-elevation myocardial infarction (STEMI)[1]. Recent investigations have noted a rising incidence of ACS in individuals under 45 years old[2–4]. Existing data suggests that this demographic constitutes 0.4–19% of all ACS cases[5]. ACS in individuals younger than 45 significantly impacts their mental and physical well-being and imposes a substantial financial burden. The risk factors, clinical presentation, and arterial involvement patterns exhibit variations between younger and older ACS patients. While the clinical

HIGHLIGHTS

- Increasing incidence of acute coronary syndrome (ACS) among individuals younger than or equal to 45 years highlights a growing health issue.
- Male predominance observed in ACS cases, particularly in older age groups, underscores the need for gender-specific preventive strategies.
- Non-ST segment elevation myocardial infarction (NSTEMI) emerges as the most common diagnosis, indicating the varied spectrum of ACS manifestations.
- Percutaneous coronary intervention (PCI) is the primary management strategy, emphasizing the importance of timely and comprehensive cardiovascular care.
- Tailored interventions targeting modifiable risk factors like smoking and hypertension are imperative to mitigate the burden of ACS in young individuals.

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trajectory of ACS in older populations is well-documented, there is limited research on the younger demographic[6].

ACS in the young population significantly impacts their quality of life[7]. Numerous studies have investigated this disease and its predictors in young individuals. However, a consistent age cut-off for defining the young population is lacking in these studies. Some have proposed 40 years as an appropriate cut-off[6,8]. Other studies considered the age of 45 as a cut-off point[9]. Moreover, there is a scarcity of high-quality data on age-specific risks for developing ACS among young individuals. The identification and management of predictors of poor outcomes following disease management are also deficient, especially when considering age as a factor.

The imperative for studies focusing on ACS in Palestine becomes evident in light of the insufficient research conducted in this specific region. ACS is emerging as a major, if not the primary, cause of mortality in Palestine. Despite its escalating impact on public health, there is a notable scarcity of comprehensive studies addressing the unique nuances and factors associated with ACS within the Palestinian context. The urgency of this research lies in its potential to inform targeted interventions, healthcare policies, and preventive strategies tailored to the distinctive characteristics of the Palestinian population. A deeper understanding of the prevalence, risk factors, and outcomes related to ACS in Palestine is crucial for the development of effective and culturally sensitive approaches to mitigate the burden of this cardiovascular condition, ultimately contributing to improved health outcomes and reduced mortality rates in the region.

Hence, this study aims to assess the clinical characteristics, age-specific clinical profiles, gender-based differences, treatment methods, and angiographic profiles of ACS in patients aged 45 years or younger, comparing them with older ACS patients (aged over 45 years) within the Palestinian population.

Table 1

Shows the demographic and lifestyle characteristics of the study participants

Characteristic	*N*	Overall *N* = 468[a]	≤ 45 *N* = 137[a]	> 45 *N* = 331[a]	*P*[b]
Sex	468				0.2
Female		59 (13)	13 (9.5)	46 (14)	
Male		409 (87)	124 (91)	285 (86)	
Education level	468				0.005
Educated		233 (50)	82 (60)	151 (46)	
Uneducated		235 (50)	55 (40)	180 (54)	
No. working days per week	466				0.045
≤ 4		125 (27)	28 (20)	97 (29)	
> 4		341 (73)	109 (80)	232 (71)	
Working hour per week	468				0.002
≤ 50		260 (56)	61 (45)	199 (60)	
> 50		208 (44)	76 (55)	132 (40)	
Place of residence	468				0.10
Rural		263 (56)	85 (62)	178 (54)	
Urban		205 (44)	52 (38)	153 (46)	
Physical activity	468				< 0.001
Non-Sedentary		166 (35)	75 (55)	91 (27)	
Sedentary		302 (65)	62 (45)	240 (73)	
Physical activity frequency week	468				< 0.001
< 2 times		370 (79)	89 (65)	281 (85)	
> 5 times		28 (6.0)	10 (7.3)	18 (5.4)	
2–5 times		70 (15)	38 (28)	32 (9.7)	
BMI categories	468				0.6
Under weight		1 (0.2)	0	1 (0.3)	
Normal weight		60 (13)	14 (10)	46 (14)	
Obese		188 (40)	59 (43)	129 (39)	
Overweight		219 (47)	64 (47)	155 (47)	

[a]*n* (%).
[b]Pearson's χ^2 test; Fisher's exact test.

Methods and material

This bidirectional study enroled a total of 468 participants and is designed to comprehensively investigate ACS. The study targeted individuals aged 18–55 years who had been diagnosed with ACS and subsequently admitted to the cardiology departments of three prominent Palestinian hospitals. These selected centres are equipped with percutaneous coronary intervention (PCI) facilities, ensuring comprehensive cardiovascular care. The data for the study were meticulously gathered from the medical records of eligible patients within the specified hospitals. The determination of the sample size was accomplished utilizing Epi-info (epidemiological information, statistical program, version 7.2.5). The calculated sample size of 468 participants was based on a 95% CI, a 2.5% margin of error, and an expected frequency of 8.3%, ensuring statistical robustness for meaningful analysis and interpretation of the study findings. The *P* value less than 0.05 was considered significant. We performed statistical analysis using R programming language version 4.1.2. This work has been reported in line with the STROCSS criteria[10].

Results

A total of 468 participants were included in the study. The Table 1 presents demographic and lifestyle characteristics of the study population, categorized by age groups (≤ 45 and > 45). In terms of gender distribution, the majority of participants were male, constituting 87% ($N = 409$) of the overall sample, with a higher proportion in the older than 45 age group (91%). Educational levels varied, with 50% ($N = 233$) of participants being educated. Regarding occupational factors, a significant proportion worked more than four days per week (73%), and the majority worked 50 h or less per week (56%). In terms of residence, 56% lived in rural areas, and lifestyle factors indicated that 65% of participants had a sedentary lifestyle. Physical activity frequency per week showed that 79% engaged in activity less than twice a week. Lastly, BMI categories illustrated that 47% of participants were overweight. These descriptive statistics provide a snapshot of the demographic and lifestyle characteristics within each age group.

Table 2 presents a detailed breakdown of demographic and lifestyle characteristics based on gender within the study participants. Among the 468 participants, 233 (50%) were educated, with a relatively even distribution between females and males (46% and 50%, respectively). Regarding the number of working days per week, the majority (73%) worked more than four days, with a higher proportion of males falling into this category (81%). In terms of working hours per week, 56% worked 50 h or less, with a notable gender difference (95% of females and 50% of males). Age distribution revealed that 71% of participants were over 45 years old, with a higher percentage of males in this

Table 2

Presents a detailed breakdown of demographic and lifestyle characteristics based on gender of participants

Characteristic	N	Overall N = 468[a]	Female N = 59[a]	Male N = 409[a]
Education Level	468			
Educated		233 (50)	27 (46)	206 (50)
Uneducated		235 (50)	32 (54)	203 (50)
No. working days per week	466			
≤ 4		125 (27)	47 (81)	78 (19)
> 4		341 (73)	11 (19)	330 (81)
Working hour per week	468			
≤ 50		260 (56)	56 (95)	204 (50)
> 50		208 (44)	3 (5.1)	205 (50)
Age group	468			
≤ 45		137 (29)	13 (22)	124 (30)
> 45		331 (71)	46 (78)	285 (70)
Place of residence	468			
Rural		263 (56)	36 (61)	227 (56)
Urban		205 (44)	23 (39)	182 (44)
Physical activity	468			
Non-Sedentary		166 (35)	13 (22)	153 (37)
Sedentary		302 (65)	46 (78)	256 (63)
Physical activity frequency week	468			
< 2 times		370 (79)	53 (90)	317 (78)
> 5 times		28 (6.0)	3 (5.1)	25 (6.1)
2–5 times		70 (15)	3 (5.1)	67 (16)
BMI categories	468			
Under weight		1 (0.2)	0	1 (0.2)
Normal weight		60 (13)	4 (6.8)	56 (14)
Overweight		219 (47)	19 (32)	200 (49)
Obese		188 (40)	36 (61)	152 (37)

[a]*n* (%).

Table 3

Shows the clinical presentations, diagnostic features, and outcomes among the study participants categorized by age groups (≤ 45 and > 45)

Characteristic	N	Overall N = 468[a]	≤ 45 N = 137[a]	> 45 N = 331[a]	P[b]
Presentation	468				0.4
Acute HF (pulmonary oedema)		5 (1.1)	0	5 (1.5)	
Arrhythmia		10 (2.1)	1 (0.7)	9 (2.7)	
Cardiac arrest		4 (0.9)	1 (0.7)	3 (0.9)	
Cardiogenic shock		4 (0.9)	1 (0.7)	3 (0.9)	
None		445 (95)	134 (98)	311 (94)	
Killip classification	468				0.6
Class 1 (no evidence of HF)		443 (95)	133 (97)	310 (94)	
Class 2 (S3, lung rales or JVD)		17 (3.6)	3 (2.2)	14 (4.2)	
Class 3 (pulmonary oedema)		7 (1.5)	1 (0.7)	6 (1.8)	
Class 4 (Cardiogenic shock)		1 (0.2)	0	1 (0.3)	
Troponin I T	466				0.7
≤ 14		213 (46)	60 (44)	153 (46)	
> 14		253 (54)	76 (56)	177 (54)	
Anaemia	468				0.3
Present		398 (85)	120 (88)	278 (84)	
Absent		70 (15)	17 (12)	53 (16)	
Platelet count	468				0.4
Normal		430 (92)	130 (95)	300 (91)	
Thrombocytopenia		27 (5.8)	5 (3.6)	22 (6.6)	
Thrombocytosis		11 (2.4)	2 (1.5)	9 (2.7)	
Creatinine (mg/dl)	468				0.2
Increased		36 (7.7)	7 (5.1)	29 (8.8)	
Normal		432 (92)	130 (95)	302 (91)	
Diagnosis	468				0.3
NSTEMI		223 (48)	73 (53)	150 (45)	
STEMI		163 (35)	42 (31)	121 (37)	
Unstable angina		82 (18)	22 (16)	60 (18)	
Days in hospital stay	468				0.12
< 2		133 (28)	46 (34)	87 (26)	
2		160 (34)	36 (26)	124 (37)	
3		111 (24)	36 (26)	75 (23)	
> 3		64 (14)	19 (14)	45 (14)	

HF, heart failure; JVD, jugular venous distention; NSTEMI, non-ST segment elevation myocardial infarction; STEMI, ST-elevation myocardial infarction.

[a]*n* (%).

[b]Fisher's exact test; Pearson's χ^2 test.

age group (78%). The majority of participants resided in rural areas (56%), and physical activity patterns showed that 65% had a sedentary lifestyle, particularly prominent among males (78%). The frequency of physical activity per week indicated that 79% engaged in activity less than twice a week, with a higher percentage among males (90%). BMI categories reflected a distribution of 47% overweight and 40% obese individuals, with a higher prevalence of obesity among males (61%).

Table 3 provides a detailed overview of clinical presentations, diagnostic features, and outcomes among the study participants categorized by age groups (≤ 45 and > 45). The majority of patients, constituting 95% of the total, presented with no complications at presentation. Acute heart failure (pulmonary oedema), arrhythmia, cardiac arrest, and cardiogenic shock were relatively uncommon, with prevalence ranging from 0.9 to 2.7%. Notably, no cases of Acute Heart Failure were reported in the older than > 45 age group. The Killip classification system, used to assess the severity of heart failure, demonstrated that the majority of patients fell into Class 1 (no evidence of heart failure), comprising 95% of the total cohort. Classes 2, 3, and 4, representing increasing severity, were less common, collectively constituting 5% of the study population. The Troponin I T levels showed a relatively balanced distribution, with 54% of patients having positive troponin. Anaemia was prevalent in 85% of cases, while platelet count variations included 92% with normal counts, 5.8% with thrombocytopenia, and 2.4% with thrombocytosis. Creatinine levels were increased in 7.7% of cases, with the majority having normal levels (92%). The most common diagnosis was NSTEMI, accounting for 48% of cases, followed by STEMI at 35%, and Unstable Angina at 18%. The duration of hospital stay varied, with the majority of patients (34%) staying for 2 days, while 28% stayed for less than 2 days, 24% for 3 days, and 14% for more than 3 days.

Table 4 shows a comprehensive overview of health-related behaviours, cardiovascular risk factors, family histories, and COVID-19 experiences within the study population. Among the study participants, 77% had a current or previous smoking history, with a slightly higher prevalence in the younger than or equal to 45 age group (82%). Hypertension was prevalent in 51% of the overall population, with a higher incidence in the

Table 4

Shows the health-related behaviours, cardiovascular risk factors, family histories, and COVID-19 experiences within the study population

Characteristic	N	Overall N = 468[a]	≤ 45 N = 137[a]	> 45 N = 331[a]	P[b]
Smoking history	468				0.066
Current/ex		360 (77)	113 (82)	247 (75)	
Non/passive		108 (23)	24 (18)	84 (25)	
Hypertensive	468	238 (51)	47 (34)	191 (58)	< 0.001
Diabetic	468	173 (37)	39 (28)	134 (40)	0.014
Family history of CAD	468				0.5
Negative		179 (38)	49 (36)	130 (39)	
Positive		289 (62)	88 (64)	201 (61)	
The degree of family relative with CAD	468				0.8
1st degree		254 (54)	78 (57)	176 (53)	
2nd degree		35 (7.5)	10 (7.3)	25 (7.6)	
Unknown		179 (38)	49 (36)	130 (39)	
Family history of stroke	468	108 (23)	30 (22)	78 (24)	0.7
History of COVID-19 infection	468	218 (47)	65 (47)	153 (46)	0.8
Vaccinated against COVID-19	468	356 (76)	111 (81)	245 (74)	0.11
Death due to CAD	68				0.5
< 65		65 (96)	20 (100)	45 (94)	
≥ 65		3 (4.4)	0	3 (6.3)	

CAD, coronary artery disease.
[a]*n* (%).
[b]Pearson's χ^2 test; Fisher's exact test.

Table 5

Provide insights into the lipid profile of the study population

Characteristic	N	Overall, N = 468[a]	≤ 45, N = 137[a]	> 45, N = 331[a]	P[b]
Total cholesterol	463				0.4
Normal		268 (58)	75 (55)	193 (59)	
High		195 (42)	61 (45)	134 (41)	
LDL	462				0.8
Normal		257 (56)	77 (57)	180 (55)	
High		205 (44)	59 (43)	146 (45)	
HDL	464				0.4
Normal		172 (37)	46 (34)	126 (38)	
Low		292 (63)	90 (66)	202 (62)	
Triglyceride	464				0.7
Normal		198 (43)	56 (41)	142 (43)	
High		266 (57)	80 (59)	186 (57)	

HDL, high density lipoprotein; LDL, low density lipoprotein.
[a]*n* (%).
[b]Pearson's χ^2 test.

older than 45 age group (58%). Diabetes was present in 37% of the participants, with a relatively lower prevalence in the younger than or equal to 45 age group (28%). A notable proportion of participants had a positive family history of coronary artery disease (CAD), constituting 62% of the total cohort. The degree of family relative with CAD was predominantly 1st degree (54%), with 7.5% having a second degree. The prevalence of a family history of stroke was 23%. Approximately 47% of participants reported a history of COVID-19 infection, with a balanced distribution between age groups. Moreover, 76% of the study population had been vaccinated against COVID-19, with a slightly higher vaccination rate in the younger than or equal to 45 age group (81%). The family history of death due to CAD is 13.9% in relation to the general population, 14.6% for those under the 45 and 13.6% for those above the 45.

Among the study participants, 58% had normal total cholesterol levels, with a slightly higher percentage in the older than 45 age group (59%). Approximately 42% exhibited high total cholesterol levels, and this trend was more prevalent in the younger than or equal to 45 age group (45%). Analysis of LDL levels revealed that 56% of participants had normal levels, with a comparable distribution between age groups. Conversely, 44% had high LDL levels, with a slightly higher prevalence in the older than > 45 age group (45%). Regarding HDL levels, 37% of participants had normal levels, with a slightly higher percentage in the older than 45 age group (38%). However, the majority (63%) exhibited low HDL levels, with a higher prevalence in the younger than or equal to 45 age group (66%). Approximately 43% of participants had normal triglyceride levels, with a similar distribution between age groups. Conversely, 57% had high triglyceride levels, with a slightly higher prevalence in the younger than or equal to 45 age group (59%) as illustrated in Table 5.

Table 6

Illustrate the management strategy of patients

Characteristic	N	Overall N = 468[a]	≤ 45 N = 137[a]	> 45 N = 331[a]	P[b]
Management	468				0.8
Conservative treatment		78 (17)	24 (18)	54 (16)	
PCI		390 (83)	113 (82)	277 (84)	
PCI arterial access	468				0.8
Conservative		78 (17)	24 (18)	54 (16)	
Femoral		27 (5.8)	9 (6.6)	18 (5.4)	
Radial		363 (78)	104 (76)	259 (78)	
No. affected vessels	390				0.4
1		254 (65)	81 (72)	173 (62)	
2		96 (25)	22 (19)	74 (27)	
3		34 (8.7)	9 (8.0)	25 (9.0)	
4		6 (1.5)	1 (0.9)	5 (1.8)	
No. placed stents	390				0.3
1		295 (76)	92 (81)	203 (73)	
2		72 (18)	15 (13)	57 (21)	
3		20 (5.1)	5 (4.4)	15 (5.4)	
4		3 (0.8)	1 (0.9)	2 (0.7)	
Type of stent	468				0.9
Conservative		78 (17)	24 (18)	54 (16)	
bare metal stent		2 (0.4)	0	2 (0.6)	
Drug-eluting stent		388 (83)	113 (82)	275 (83)	
Staged PCI	468				0.9
Conservative		78 (17)	24 (18)	54 (16)	
No		319 (68)	94 (69)	225 (68)	
Yes		71 (15)	19 (14)	52 (16)	
Staged CABG	468				0.3
Conservative		78 (17)	24 (18)	54 (16)	
No		383 (82)	113 (82)	270 (82)	
Yes		7 (1.5)	0	7 (2.1)	

CABG, coronary artery bypass grafting; PCI, Percutaneous coronary intervention.
[a]*n* (%).
[b]Pearson's χ^2 test; Fisher's exact test.

Table 7

Shows the medications of patients during the hospital stay and at discharge

Characteristic	Overall $N=468$[a]	≤ 45 N = 137[a]	> 45 $N=331$[a]	P[b]
Medications at hospital				
Aspirin	440 (94)	129 (94)	311 (94)	> 0.9
Clopidogrel	306 (65)	86 (63)	220 (66)	0.4
Prasugrel	18 (3.8)	4 (2.9)	14 (4.2)	0.5
Ticagrelor	125 (27)	43 (31)	82 (25)	0.14
Beta-blockers	394 (84)	120 (88)	274 (83)	0.2
ACEi or ARB	270 (58)	78 (57)	192 (58)	0.8
Statins	424 (91)	125 (91)	299 (90)	0.8
Spironolactone	56 (12)	16 (12)	40 (12)	> 0.9
Diuretics	59 (13)	11 (8.0)	48 (15)	0.055
Heparins (Enoxaparin or UFH)	243 (52)	71 (52)	172 (52)	> 0.9
GP IIIa/IIb inhibitors (Tirofiban, Eptifibatide)	5 (1.1)	1 (0.7)	4 (1.2)	> 0.9
Medications on discharge				
Dual antiplatelet therapy	459 (98)	130 (95)	329 (99)	0.003
Beta-blockers	418 (89)	127 (93)	291 (88)	0.13
Antihypertensives	292 (62)	81 (59)	211 (64)	0.3
Diuretics	86 (18)	20 (15)	66 (20)	0.2
Statins	456 (97)	131 (96)	325 (98)	0.12
SGLT.2. inhibitors (dapagliflozin, forxiga)	67 (14%)	15 (11%)	52 (16%)	0.2
Diabetic medications	148 (32)	34 (25)	114 (34)	0.042

[a] *n* (%).
[b] Pearson's χ^2 test; Fisher's exact test.

Table 6 demonstrate the treatment and intervention strategies employed in the management of included patients. Among the study participants, 83% underwent PCI, while 17% received conservative treatment. This distribution was relatively consistent across both age groups, with PCI being the predominant management strategy. The majority of participants undergoing PCI received radial access (93%), while femoral access was utilized in 7%. Both age groups exhibited similar trends in PCI arterial access, with radial access being the most commonly utilized method. Among those undergoing PCI, the distribution of the number of affected vessels was as follows: 65% had one vessel affected, 25% had two vessels affected, 8.7% had three vessels affected, and 1.5% had four vessels affected. The distribution was relatively consistent between age groups. In cases where PCI was performed, 76% received one stent, 18% received two stents, 5.1% received three stents, and 0.8% received four stents. The distribution of the number of placed stents was generally similar between age groups. Among participants undergoing PCI, drug-eluting stents were predominantly used (99.5%), and a minimal percentage received bare metal stents (0.5%). Both age groups showed comparable patterns in the type of stent used. Approximately 68% of participants did not undergo staged PCI, while 15% had staged PCI. A similar trend was observed for staged coronary artery bypass grafting (CABG), with the majority (82%) not undergoing staged CABG.

As showed in Table 7, aspirin was administered to 94% of the overall cohort, with consistent usage in both age groups (≤ 45 and > 45 years). Clopidogrel, another antiplatelet agent, was given to 65% of patients, demonstrating a slightly higher prevalence in the older than 45 age group (66%). More potent antiplatelet medications, such as Prasugrel and Ticagrelor, were prescribed to 3.8% and 27% of patients, respectively, with Ticagrelor being more commonly used in the younger than or equal to 45 age group. Beta-blockers, ACE inhibitors or ARBs, statins, and heparins were widely administered during hospitalization, showcasing comprehensive cardiovascular management. On discharge, the majority of patients received dual antiplatelet therapy (98%), beta-blockers (89%), and statins (97%), emphasizing the continuation of essential post-ACS medications. Antihypertensives, diuretics, SGLT-2 inhibitors, and diabetic medications were also commonly prescribed at discharge, ensuring a holistic approach to cardiovascular care in the post-hospitalization period. These results underscore the significance of a well-rounded pharmacological strategy in the management of ACS patients, with consideration for age-specific variations.

Discussion

ACS in young patients has many definitions with variable cut-off points which can range between 30 and 55 years. The lack of uniform cut-off point to define the age for ACS in young makes the comparison between previous studies a challenging task[11]. In our present study, we use 45 years as a cut-off point to define young patients similar to previous studies conducted in Thailand, Singapore and California[12].To date, there is no similar study to the population of young patients with ACS in Palestine.

In this retrospective study, we reported the demographic and lifestyle characteristics, clinical presentations, lipid profile, health-related behaviours, cardiovascular risk factors, diagnostic features, management strategy and outcomes among the study participants categorized by age groups (≤ 45 and > 45). In our study, 29.2% of patients with ACS were less than 45 years of age. This is higher than the prevalence of young ACS reported by the Global Registry of Acute Coronary Event (GRACE) as 6.3%[13] and higher than retrospective studies conducted by Al-Shahrani and colleagues and Yilmaz and colleagues which were 16.7% and 7.4%, respectively in comparison to general population[12,14]. In the present study, ACS in young patients occurs predominantly in men (91%) which was also found in majority of populations. This could be explained by the protective effect of oestrogen in females, which prevents atherosclerosis formation in addition to the higher smoking frequencies in males[15].

Smoking, low high-density lipoprotein and hypercholesteremia are associated with ACS in young adults. Moreover, hypertriglyceridemia, obesity and insulin resistance are considered risk factors for young age ACS[16]. In the present study, young patients with ACS had higher frequencies of cardiovascular risk factors including smoking, family history and dyslipidaemia but all of them were non-significant when compared with older age patients with ACS. Smoking was reported as the predominant risk factor with a prevalence of 82%. This correlates with previous studies reported smoking as predominant and established major risk factor in young patients with ACS with prevalence ranges from 70 to 90%. The pathophysiology behind this explained by the effects of smoking on increasing fibrinogen levels, platelets aggregation and vasospasm. It was also noted that smoking reduces fibrinolytic activity and coronary flow reserve. In addition, endothelial cells damage with vascular intima injury happens with catecholamine surges as a result of recurrent

smoking exposure. Based on autopsy results of young adults, fatty-streak lesions in coronary arteries were found more in smokers than nonsmokers[17]. Moreover, a 10-year reduction in age is expected when cardiovascular events occur due to smoking, as reported by[18].

Obesity is associated with other cardiovascular risk factors, such as hypertension and diabetes, and it is considered an independent predictor of coronary artery disease[19]. 90% of young patients with acute coronary syndrome in our study were considered overweight or obese. This is higher than what is reported by Mahendiran and colleagues and Alappatt and colleagues with 66.6% and 44%, respectively, being overweight or obese in young patients with acute coronary syndrome[5,19]. Young patients with the acute coronary syndrome in our study have higher frequencies of sedentary lifestyle with less than 2 times physical activity per week. This is in line with a previous retrospective study that showed 8 out of 10 young patients with ACS were sedentary[20].

In previous studies, lipid abnormalities that are associated with an increased risk of ACS in young patients include hypertriglyceridemia, low HDL-C and independent LDL-C[14]. This correlates with our present studies as young patients with ACS are found to have hypertriglyceridemia, low HDL-C and independent LDL-C. However, no significant difference between the two age groups was found. 64% of young patients of ACS in our study was found to have a family history of ACS. This is higher than what reported by Fotedar and colleagues and Dwivedi and colleagues with only 8.52% and 18.8%, respectively, were reported to have family history[21]. Compared to patients without such a history, those with a positive family history experienced their first acute myocardial infarction over ten years earlier[17].

In our present study, the frequency of poor prognostic factors like hypertension and diabetes have been reported significantly higher in older patients. On the other hand, in a study conducted by Pandey *et al.*[9], no significant difference in the prevalence of hypertension and diabetes mellitus among young and old patients with ACS. This is also consistent with a prospective study conducted by Fallahzadeh *et al.*[18.] This could be justified to the poor screening in young age groups, which leads to under-diagnosis of these conditions.

In our study, the majority of young patients were classified as Killip class 1, but with no significant difference between the two age groups. This could be explained by the lower mean age of the older group compared to other previous studies.

Young patients with ACS were found to have a higher incidence of one-vessel disease than older ACS patients. This correlates with a study done by Gotman and colleagues who found higher incidence of patients diagnosed by angiography to have no vessel or one-vessel disease in young patients[20].

In agreement with a study conducted by Panduranag *et al.*[17] no differences were noted between the types of ACS between young or old patients. On the other hand, 53% of young patients with ACS in our study exhibited NSTEMI, while Pandey *et al.*[9] and Deshmuck and colleagues found in their studies that STEMI is more frequently observed in young patients with ACS. This is also in line with what was investigated by Tungsubutra *et al.*[22] They found that among 544 patients aged less than 45 years with acute coronary syndrome, STEMI, NSTEMI, US were reported as 67.3%, 19.3% and 13.4%, respectively.

A study conducted by Tungsubutra *et al.*[22] found that aspirin followed by statin were used to manage most of the patients under the age of 45. Similar findings were reported in our study with aspirin (94%) followed by statins (91%) were the most widely used medications for young patients with ACS. On the other hand, Beta-blockers were the most preferred medication according to Davis *et al.*[23]. PCI was the treatment of choice for young patients with ACS in accordance with previous studies[24]. Our study affirms this with 82% of young patients managed with PCI. The length of hospital stay was not statistically significant between the two age groups. This aligns with what reported in a retrospective study conducted by Al-Shahrani *et al.*[12]. On the other hand, Fan and colleagues and Kanitz and colleagues have shown in their studies longer hospital stays in older patients with ACS[25,26].

As our study and other studies have shown, risk factors for ACS in younger patients may not entirely share the same classic risk factors as those in older patients. Since these are modifiable risk factors, preventative steps to encourage quitting smoking and creating a culture that supports lifestyle modifications through the adoption of good eating habits and exercise programs are necessary.

The absence of a control group is one of the study's few significant limitations. It is the first study in Palestine, however, to assess risk variables in young ACS patients. As such, it may serve as a starting point for preventing risk factors and a warning for the early detection of coronary disease in this demographic.

Conclusion

The most common risk factors for ACS in patients under 45 are smoking, obesity, hyperlipidaemia, and a family history of coronary artery disease. Depending on the population under investigation, these risk factors vary from study to study. Therefore, it is imperative to prioritize preventative efforts like quitting smoking and raising knowledge about the harmful effects of tobacco, unhealthy eating habits, and sedentary lifestyles in order to avert the onset of cardiac complications among young adults. This can lessen cardiovascular disease burden and its physical and mental consequences in this age group. The research findings add to the body of knowledge already available on this topic and provide insightful information for future studies in Palestine and around the world.

Ethical approval

The ethical approval was obtained from Al-Quds University Ethics Committee with the reference number of 329/REC/2023. The approval to access the medical records of included patients and to conduct the study was also obtained from the ethics committees of the three involved hospitals.

Consent

Written informed consent was obtained from the participants to access their medical records for publication and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

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Author contribution

Writing the manuscript: O.N.S., Z.M.M.Z., B.Z., Y.T. Data collection: M.A.-T., A.A., A.S., A.A., A.A.J., S.A., S.H., A.M., Y.A., K.Z. Data analysis: T.A.O. Reviewing and editing the manuscript: A.J., S.M., M.N., S.N.

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All the authors had no disclosure of conflict.

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