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Risk Factors for Myocardial Infarction During Vacation Travel

WILLEM J. KOP, PHD, AD VINGERHOETS, PHD, GERT-JAN KRUITHOF, MD, AND JOHN S. GOTTDIENER, MD

Objectives: Medical emergencies occur increasingly outside the usual health care area as a result of increased leisure and professional travel. Acute coronary syndromes are the leading cause of mortality during vacation. Vacation activities include physical and emotional triggers for myocardial infarction (MI). This study examines characteristics of vacation travel as risk factors for MI. **Methods:** Patients diagnosed with MI during vacation abroad ($N = 92$; age, 59.5 ± 10.2; 79 men) were recruited through an emergency health insurance organization. Risk indicators for Vacation MI were examined and included: cardiovascular risk factors, psychosocial measures, and specific demands and activities related to vacation (eg, lodging accommodations, unfamiliar destination, mode of transportation, short-term planning). Vacation MI patients were compared with two reference groups: age-matched Vacation Controls with noncardiovascular medical emergencies ($N = 67$) and Hospital MI Controls, admitted in their usual health care area ($N = 30$). **Results:** Vacation MI occurred disproportionately (21.1%) during the first 2 days of vacation. Cardiovascular risk factors were more prevalent among Vacation MI patients than Vacation Controls (p values $< .05$) but not compared with Hospital MI Controls. Vacation MI occurred more often in patients with lower education (OR = 2.4, CI = 1.1–5.2) and those living with a spouse (OR = 2.6, CI = 1.0–7.1) than age-matched Vacation Controls. Compared with Hospital MI Controls, Vacation MI occurred more often among patients traveling by car versus other modes of transportation (OR = 2.5, CI = 1.0–6.1) and among patients staying in a tent or mobile home versus hotel (OR = 9.7, CI = 2.0–47.9). **Conclusion:** Incidence of MI during vacation is highest during the first 2 days of vacation. Vacation activities such as adverse driving conditions and less luxurious accommodations may increase risk for MI. Individuals with known vulnerability for MI may therefore benefit from minimizing physical and emotional challenges specifically related to vacation travel. **Key words:** myocardial infarction, leisure activities, risk factors, vacation, psychosocial.

CAD = coronary artery disease; CI = confidence interval; CVD = cardiovascular disease; MI = myocardial infarction; MVDI = Motivation for Vacation Destination Inventory; OR = odds ratio.

Acute coronary syndromes are the leading cause of mortality during vacation travel (1, 2). Recent trends in leisure and professional travel have resulted in a marked increase in medical emergencies occurring outside the usual health care area. Periods of leisure time, such as weekend days, are generally characterized by reduced risk of myocardial infarction (MI) (3). Previous research also suggests that taking regular vacations may reduce the risk of MI and cardiac mortality (4, 5). However, typical vacation activities include both physical and mental challenges that may act as potential triggers of MI and sudden cardiac death (6–8). These challenges include exposures to crowded traffic conditions, extreme temperatures, altered diet and exercise levels, increased alcohol consumption, traveling activities, adaptation to new environments and cultures, and distress related to unmet expectations (8, 9).

To date, no information is available regarding specific risk factors for MI during vacation. Reduced access to immediate pharmacological or mechanical revascularization often complicates cardiovascular events. In addition, substantial costs are involved if transportation is required from the vacation region to the patient's usual health care center. This study investigates whether MI during vacation is related to characteristics of vacation travel or motivations for taking vacation. Two reference groups were used to determine risk indicators for MI during vacation: 1) patients hospitalized during vacation for major medical emergencies other than MI and 2) patients hospitalized for MI in their usual health care area. We examined whether potentially burdensome factors of vacation (eg, unfamiliar destination, short-term planning, type of accommodation, vacation motives) would have adverse effects on the risk of MI, adjusting for psychosocial measures and cardiovascular risk factors (10, 11).

METHODS

Patients

Patients hospitalized for MI during vacation (Group 1: Vacation MI) were recruited through the emergency center of the Royal Dutch Touring Club (ANWB) (the Dutch equivalent of the British Automo-

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bile Association). The ANWB acts as a travel insurance agency and is contacted immediately on admission to a local hospital for a medical emergency occurring outside the Netherlands or Belgium. It is estimated that more than 85% of Dutch international travelers have an ANWB or equivalent insurance program to cover potential medical emergencies during vacation. Inclusion criteria were: 1) nonfatal myocardial infarction based on WHO criteria (enzyme rise and ECG changes), 2) repatriated from vacation because of the MI, and 3) not on business travel. A total of 131 patients were approached to participate in the study, of which 92 (70%) agreed to participate.

Control patients ($N = 262$) with major medical emergencies during vacation (Group 2: Vacation Controls) were enrolled in the same manner, using the following inclusion criteria: 1) hospitalized for medical events other than cardiovascular disease (CVD); 2) repatriated from vacation because of the medical event; and 3) not on business travel. Most Vacation Control patients required major surgery for bone fractures or were admitted for concussion. Vacation Controls were subsequently age-matched with the Vacation MI group, because age is an important factor in MI as well as vacation activities. Specifically, for each Vacation MI patient (Group 1), a Vacation Control was selected in the age range of ±3 years. This procedure resulted in 67 age-matched Vacation Controls.

To establish whether risk factors for MI during vacation were specific for vacation per se and did not merely reflect risk factors for MI in general, a second control group was included, consisting of 30 MI patients hospitalized in their usual geographic health care area (Group 3: Hospital MI Controls). These patients reported about characteristics of their latest vacation before hospitalization.

Measures

Cardiovascular risk factors. The following cardiovascular risk factors were examined: age, sex, hypertension, family history of CVD (first degree), smoking status (current, history, or nonsmoker), number of cigarettes/day, and usual alcohol consumption. Patients also provided information regarding history of CVD, other medical conditions, and anginal symptoms during the 2 months before vacation travel (chest pain, shortness of breath, fatigue).

Measures related to vacation travel. Factors related to potential burdens of vacation travel and stay included: mode of transportation (driving self vs. public transportation such as train, plane, boat, etc.); accommodation type (hotel, mobile home, tent, etc.); traveling with family or friends versus unfamiliar companions; how long in advance the vacation was planned; number of vacation days before travel; and whether the vacation destination involved a new or familiar location (8, 9).

Subjective measures of patients' motivations for choosing the specific vacation destination were obtained using the Motivation for Vacation Destination Inventory (MVDI), validated in a previous study of healthy individuals (8, 12). Based on factor analysis, five MVDI dimensions were examined: 1) seeking excitement, 2) cultural exploration, 3) seeking peace and quiet, 4) safe and comfortable environment, and 5) good weather and food. The MVDI has good total scale reliability (Cronbach $\alpha = 0.85$), with subscale reliability coefficients ranging from 0.52 to 0.97.

Psychosocial measures. Three categories of psychosocial measures were examined: 1) vacation-specific distress, 2) level of exhaustion before vacation, and 3) socioeconomic and marital status. Distress specific to vacation was reported on a five-point rating scale. Levels of exhaustion before vacation were assessed with the Maastricht Questionnaire (MQ) (13). Exhaustion is predictive of incident MI as well as recurrent events after coronary angioplasty (14, 15) and results from prolonged uncontrollable psychological distress. The psychometric properties of the MQ are good with a score range from 0 to 42 and a previously validated cutoff greater than 14 to identify exhausted individuals. Socioeconomic status was assessed using educational level and employment status. To examine effects of marital status, we compared patients living with a spouse with single, divorced, or widowed patients.

Statistical Analysis

Data are presented as percentages or means ± standard deviation (SD) when appropriate. Analysis of variance (ANOVA) was used for continuous variables. Risk indicators for MI during vacation were examined using odds ratios (OR) and 95% confidence intervals (CI) for categorical variables. Risk ratios related to the two reference groups were examined separately. Multiple logistic regression analysis was used to investigate whether vacation characteristics were related to Vacation MI, independent of cardiovascular and psychosocial measures. All models included age, sex, socioeconomic indicators (education level and employment status), and cardiovascular risk factors, and then examined additional predictive values of vacation characteristics that were significant at the univariate level. A p value < 0.05 was used as cutoff for statistical significance.

RESULTS

Cardiovascular risk factors and demographics of Vacation MI patients are presented in Table 1 (left column). The median planned duration of vacation was 19 days (range, 5–240 days). As shown in Fig. 1, MIs occurred more often during the first 2 days of vacation (21.1%) then any other 2-day period of vacation. The incidence of MI was significantly higher during morning hours (34%) compared with nighttime (16%; $p = .022$), and tapered off later in the day (27% afternoon and 23% evening events).

Comparison of Vacation MI Patients With Vacation Controls

Cardiovascular risk factors. As shown in Table 1, Vacation MI patients were more likely to have a prior diagnosis of coronary artery disease (CAD) and standard cardiovascular risk factors (male gender, hypertension, and a positive family history for CVD) than Vacation Controls. Adverse health behaviors including smoking and alcohol consumption did not differ between Vacation MI patients and Vacation Controls. Anginal symptoms during the 2 months before vacation occurred in MI patients (35.3% chest pain, 37.5% dyspnea) but did not occur in any of the Vacation Controls.

Vacation characteristics. Table 2 shows that Vacation MI patients visited familiar destinations more frequently than Vacation Controls (OR = 1.9, CI = 1.0–3.6). None of the other vacation characteristics distinguished Vacation MI from Vacation Control patients.

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TABLE 1. Demographic and Cardiovascular Risk Factors for Myocardial Infarction During Vacation

	Vacation MI	Reference Group: Vacation Control OR (95% CI)		Reference Group: Hospital MI Control OR (95% CI)	
Age > 55 yrs	65.2%	55.2%	1.5 (0.8–2.9)	56.7%	1.4 (0.6–3.3
Gender (male)	85.9%	70.1%	2.6 (1.2–5.7)*	96.7%	0.2 (0.1–1.7)
Positive history of CVD	30.4%	14.9%	2.5 (1.1–5.6)*	36.7%	0.8 (0.3–1.8)
Hypertension	23.6%	8.5%	3.4 (1.2–9.4)*	25.9%	0.9 (0.3–2.4)
Alcohol consumptions/week					
1 or less	31.5%	24.6%	1.0	25.0%	1.0
1–10	46.7%	46.2%	0.8 (0.4–1.7)	35.7%	1.0 (0.4–3.0)
>10	21.7%	29.2%	0.6 (0.2–1.4)	39.3%	0.4 (0.1–1.3)
Smoking					
Never	12.0%	16.7%	1.0	10.0%	1.0
History	39.1%	24.2%	2.2 (0.8–6.3)	26.7%	1.2 (0.3–5.4)
Current	48.9%	59.1%	1.2 (0.5–3.0)	63.3%	0.6 (0.2–2.6)
Family history of CVD	63.0%	35.89%	3.1 (1.6–5.9)**	73.3%	0.6 (0.2–1.5)

OR = odds ratio; CI = confidence interval; CVD = cardiovascular disease. Odds ratio for Vacation MI are calculated using two reference groups: Vacation Controls (N = 67) and Hospital MI Controls (N = 30).
* $p < .05$; ** $p < .01$.

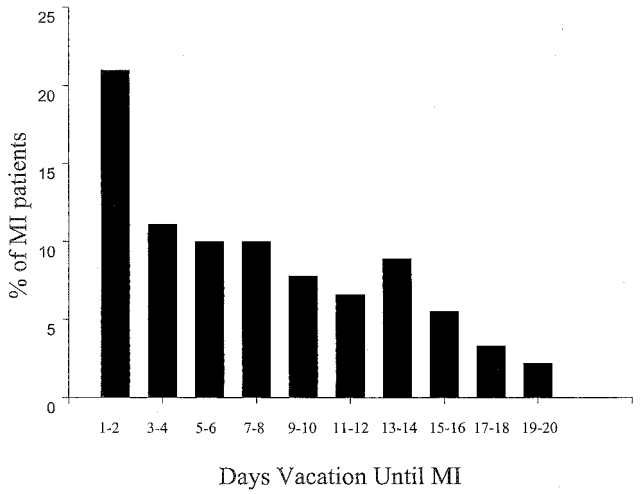

Fig. 1. Probability of myocardial infarction (MI) as related to duration of vacation. MI was disproportionately present during the first 2 days of vacation compared with all other 2-day periods.

As shown in Fig. 2, Vacation MI patients were less likely to take vacation for cultural exploration purposes p = .04) than Vacation Controls. No other differences in specific motivations for choosing the vacation destinations were found

Psychosocial measures. Vacation MI patients experienced distress specifically related to the vacation in 11.1% of the cases, which was not significantly different from Vacation Controls (14.1%, $p > .10$).

Exhaustion before vacation travel was also not elevated among Vacation MI versus Vacation Controls (OR = 1.3, CI = 0.6–2.8). Vacation MI patients were more likely to live with a spouse than the age-matched Vacation Controls (OR = 2.6, CI = 1.0–7.1). Finally, a lower education level was more prevalent among Vacation MI patients than Vacation Controls (OR = 2.4, CI = 1.1–5.2).

Comparison of Vacation MI With MI Occurring in Usual Health Care Setting

Cardiovascular risk factors. No significant differences were found in the prevalence of risk factors among Vacation MI patients versus Hospital MI Controls (Table 1). Anginal complaints or dyspnea during the 2 months before vacation travel were also similar for Vacation MI patients and Hospital MI Controls (35.3% vs. 25.0% chest pain; 37.5% vs. 23.3% dyspnea; p value > 0.10). Thus, Vacation MI patients (Group 1) did not display a distinct cardiovascular risk pattern compared with other MI patients (Group 3).

Vacation characteristics. Hospital MI Controls reported about their most recent vacation and Vacation MI patients reported about the vacation during which the MI occurred. There were no significant differences in the time lag between the time of vacation and the time of completion of the MVDI between the two groups ($p > .10$). As shown in Table 2, MI was more likely to occur during vacation than in the usual health care area when patients traveled by car versus other modes of transportation (OR = 2.5, CI = 1.0–6.1), stayed in a tent or mobile home versus hotel (OR = 9.7, CI = 2.0–47.9), and if familiar destinations were visited (OR = 3.7, CI = 1.5–9.3).

Vacation MI patients were less inclined to select

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TABLE 2. Relation Between Vacation Characteristics and MI During Vacation

	Vacation MI	Vacation Control		Hospital MI Control	
Transportation by car	72.9%	71.4%	1.1 (0.5–2.2)	51.9%	2.5 (1.0–6.1)*
Type of accommodation					
Hotel	22.2%	29.7%	1.0	46.4%	1.0
Apartment	44.4%	34.4%	1.7 (0.8–3.9)	46.4%	2.0 (0.8–5.1)
Tent/mobile home	33.3%	35.9%	1.2 (0.5–2.8)	7.1%	9.7 (2.0–47.9)*
Companion					
Family or spouse	72.2%	76.3%	1.0	59.3%	1.0
Friends, group, alone	27.8%	23.7%	1.2 (0.6–2.6)	40.7%	0.6 (0.2–1.4)
Planned less than 2 months in advance	24.7%	29.2%	0.8 (0.4–1.6)	25.9%	0.9 (0.4–2.5)
Vacation days before travel					
2 days or more	27.3%	32.8%	1.0	42.3%	1.0
1 day or less[a]	12.5%	23.0%	0.7 (0.2–1.8)	23.1%	0.8 (0.2–2.9)
Familiar destination	65.2%	50.0%	1.9 (1.0–3.6)*	33.3%	3.7 (1.5–9.3)*

OR = odds ratio, CI = confidence interval.
* $p < 0.05$ compared to Vacation MI group.
[a] Patients who were retired or not employed (60.2%) were not included in this comparison.

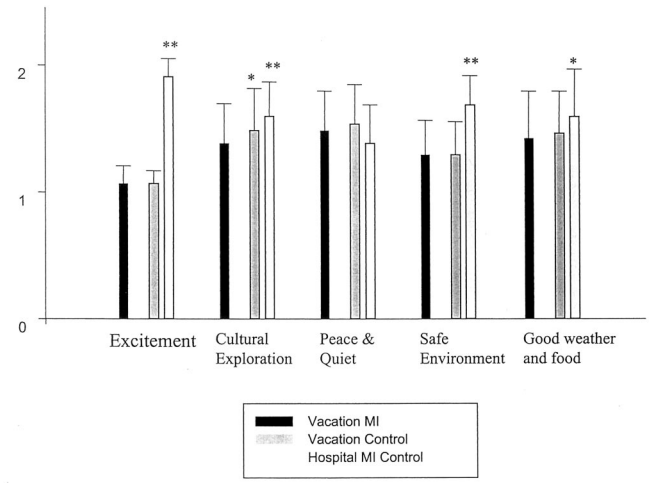

Fig. 2. Relationship between Vacation MI and motivations for taking vacation using Vacation Controls and Hospital MI patients as comparison groups.

challenging vacations than Hospital MI Controls: lower MVDI levels were found for exciting vacation environment ($p < .001$), pursuing culturally interesting locations ($p = .002$), seeking safe environments ($p = .001$), or selection of locations based on food and weather ($p = .046$) (Figure 2). No motivational differences were found to be predictors of MI for patients with a known history of CAD versus MI patients without prior CAD.

Psychosocial risk factors. No differences in vacation-specific or prior exhaustion levels were found between Vacation MI and Hospital MI Controls (p value $> .10$). Education level or occupational status did not differ between Vacation MI patients and Hospital MI Controls. Although Vacation MI patients were retired twice as often as compared with both reference groups, these differences failed to reach statistical significance.

Multivariate Analysis

Multivariate logistic regression analyses were used to examine whether vacation characteristics were predictive of Vacation MI when adjusting for age, measures of socioeconomic status (education level and employment status), and significant cardiovascular risk factors (history of CAD, hypertension, and family history of CVD). Preferences for familiar destinations remained predictive of Vacation MI compared with Vacation Controls (OR = 2.2, CI = 1.1–4.8); adjusting for lower education level (OR = 1.8, CI = 1.1–2.9); employment status (OR = 1.0, CI = 0.6–2.0); age (OR = 1.02, CI = 0.97–1.07 per year); hypertension (OR = 3.9, CI = 1.1–13.4); known history of CAD (OR = 0.8, CI = 0.7–4.5); and family history of CVD (OR = 2.5, CI = 1.1–5.2).

Multivariate analyses with Hospital MI Controls as the reference group revealed that Vacation MI patients traveled by car rather than other modes of transportation (OR = 3.2, CI = 1.1–8.8); adjusting for lower education level (OR = 0.9, CI = 0.5–1.7); employment status (OR = 1.2, CI = 0.6–2.7); age (OR = 1.06, CI = 1.00–1.12); hypertension (OR = 0.9, CI = 0.3–2.9); known history of CAD (OR = 0.5, CI = 0.1–1.9); and family history of CVD (OR = 0.4, CI = 0.1–1.3). Staying in a tent or mobile home (OR = 13.4, CI = 2.3–77.4) and visiting a familiar destination (OR = 5.3, CI = 1.7–16.4) remained significant after correction for demographic and cardiovascular covariates.

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DISCUSSION

This study demonstrates that the incidence of MI during vacation is highest during the first 2 days of vacation (21.1% of all vacation MIs). The present findings further suggest that driving by car to the vacation destination and staying in a tent or mobile home may increase risk of MI during vacation among high-risk individuals. These circumstances of vacation travel and accommodation may pose physical and mental burdens that could act as triggers of MI during vacation, particularly among individuals with a high vulnerability for cardiovascular events.

Two comparison groups were used in the present study: 1) age-matched Vacation Controls to examine risk factors specific to MI during vacation and 2) Hospital MI Controls to examine risk factors for MI during vacation versus MIs occurring in the usual medical setting irrespective of taking vacation. Comparison with the first reference group – Vacation Control patients – revealed that traditional cardiovascular CAD risk factors, such as hypertension and a positive family history of CAD, were strong predictors of MI during vacation. However, these CAD risk factors for Vacation MI were equally prevalent among patients who experienced MI in their usual health care area and, thus, CAD risk factors and symptoms cannot be regarded as specific for Vacation MI per se, but rather reflect risk factors for MI in general.

As indicators of physical and psychological demands of vacation travel, we considered both objective and subjective measures of vacation circumstances and motives. Objective measures included: mode of transportation, short-term vacation planning, stay at an unfamiliar location, unknown travel companions, and how luxurious lodging accommodations were. Vacation travel by car (in contrast to other modes of transportation) and certain types of accommodations (ie, tent or mobile home) were more common among Vacation MI patients than Hospital Control MI patients. Potentially distressing aspects of these vacation circumstances include unexpected traffic jams, impatience and irritability of travel companions, conflicts with travel companions, and lack of privacy (8). Although the Vacation MI patients did not differ in socioeconomic status from Hospital MI Controls, we cannot exclude the possibility that reduced financial resources partially accounted for the observed associations. The results regarding accommodation and mode of transportation are important given the fact that the first 2 days of vacation were associated with the highest risk of MI.

Subjective measures of psychological burden included perceived distress of vacation and motivations for taking vacation. No evidence was found to support that Vacation MI patients were particularly inclined to seek out exciting or otherwise challenging vacations, and vacation motivations were generally less explicit among Vacation MI patients compared with MI patients hospitalized in their home environment. In contrast to our expectations, living with a spouse and visiting familiar destinations were more frequently observed in Vacation MI patients than in either of the two control groups. We further anticipated that measures of psychosocial distress would moderate the effects of challenging vacation conditions, such as lack of access to social support and being exhausted at the time of vacation travel (10, 11). However, no adverse effects of these psychosocial measures on vacation challenges were observed.

Limitations

The present study did not assess acute triggers and focused on relatively long-term circumstances specifically related to taking vacation. Vacation travel is often associated with increased engagement in activities that can act as important triggers of MI, such as acute effects of exercise, alcohol intake, sexual activities, and mental stress (1, 8, 16). However, Vacation MI patients tended to seek *less* exciting or interesting destinations than patients who experienced their MI at home or who had other medical emergencies during vacation. Thus, although vacation may increase exposure to extreme temperatures and activities that may act as acute triggers of cardiac ischemia, it is unlikely that Vacation MI patients display an exaggerated pattern of risk-taking tendencies during their vacation activities.

Cardiovascular risk factors other than those examined in the present study may have differed between patients who suffered MI during vacation versus patients who suffered MI in their home environment, including lipid levels, body mass index, exercise levels, and glucose levels. We also limited our investigation to nonfatal MI and have no information on predictors of cardiac mortality during vacation.

Finally, results may have been influenced by retrospective report bias because patients experienced their cardiac event before completing the assessments of exposures. To adjust for this potential bias, we used an age-matched group of patients who suffered a major clinical event during their vacation and a group of patients with MI in their usual health care area. In addition, most evidence indicates that retrospective reports overestimate risk ratios in cardiovascular research (17). The conclusions that can be drawn from this study are limited by the restrictions inherent to

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case-control designs. The case-crossover methodology is not applicable for the present research question because characteristics of vacation travel (ie, exposure) are unlikely to occur at times other than before and during vacation. Finally, the age-matching procedure applied to the Vacation Control patients (group 2), may have introduced a bias toward underdetection of potential risk factors for MI. Thus, prospective studies are needed to further establish risk factors for MI during vacation travel.

Clinical Implications

Given the recent trends in leisure and professional travel, an increasing number of MIs occur outside the usual health care area (1, 8). MI is often the first sign of underlying CAD and, consistent with prior studies, less than one-third of patients with MI during vacation had a known history of CAD. Hence, it is important to establish risk indicators of MI during vacation travel in asymptomatic individuals. The present study suggests that traveling by car and residing in less luxurious accommodations may increase the risk of MI in vulnerable patients. Cardiovascular risk factors, known history of CAD, or socioeconomic status did not differ between Vacation MI patients and patients who suffered MI in their usual health care area.

Epidemiological research indicates that taking vacations regularly reduces the risk of MI (4, 5). Some evidence also suggests a higher incidence of out-of-hospital MI during the Christmas holiday season (December 25–31) compared with the preceding week (18). These cardiac events may, in part, result from a higher incidence of acute triggers during these days, such as large meals and intense emotions. Similarly, vacation travel has been described as potentially distressing (8, 19). The circumstances under which these triggers occur are generally atypical during vacation travel and patients may be unaware of potential risks associated with environmental factors such as extreme temperatures, unexpected psychological demands related to vacation travel, and lack of privacy in less luxurious accommodations. These challenges may be more salient for individuals who are retired and/or who have relatively unstrained usual activity levels. High-risk patients need to be alerted to the unique physical and mental activities specific to vacation travel that can act as triggers of acute coronary syndromes during their vacation.

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