2000

Differences in diagnostic category, symptoms, and sociodemographic characteristics among patients presenting to emergency departments with symptoms of acute myocardial infarction.

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DIFFERENCES IN DIAGNOSTIC CATEGORY, SYMPTOMS, AND SOCIODEMOGRAPHIC CHARACTERISTICS AMONG PATIENTS PRESENTING TO EMERGENCY DEPARTMENTS WITH SYMPTOMS OF ACUTE MYOCARDIAL INFARCTION

by

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A DISSERTATION

Submitted to the graduate faculty of The University of Alabama at Birmingham, in partial fulfillment of the requirements for the degree of Doctor of Philosophy

BIRMINGHAM, ALABAMA

2000

UMI Number: 9997044

Bell & Howell Information and Learning Company
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ABSTRACT OF DISSERTATION
GRADUATE SCHOOL, UNIVERSITY OF ALABAMA AT BIRMINGHAM

Degree PhD Program Public Health

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Committee Chairs James M. Raczynski, Carol E. Cornell

Title Differences in Diagnostic Category, Symptoms, and Sociodemographic Characteristics Among Patients Presenting to Emergency Departments With Symptoms of Acute Myocardial Infarction

Objectives. Most patients diagnosed with acute myocardial infarction (AMI) report chest pain or some other chest sensation, but other symptoms may accompany a heart attack, regardless of the presence or absence of chest pain. Evidence suggests that sociodemographic characteristics are associated with differences in AMI symptomatology. Symptom characteristics influence patient care seeking and clinician triage and treatment decisions, and, therefore, may affect prognosis. The purpose of this study was to determine whether there were differences in sociodemographics, symptoms, and diagnostic categories in a selected group of emergency department (ED) patients with chest symptoms presumptive of AMI.

Methods. These data were collected as part of the Rapid Early Action for Coronary Treatment (REACT) Study, a multicenter community intervention trial. Information was abstracted from medical charts of patients who presented to 43 hospital EDs in 20 study communities. Eligibility was restricted to patients who presented with chest pain or other chest symptoms. Abstracted data included patient demographics, presence or absence of 21 symptoms, and diagnoses. The final sample consisted of 5,358 White, Black, or Hispanic patients.

Results. There were statistically significant differences in diagnostic category based on sex, ethnicity, and age group. Males, Whites, and older patients were more likely than females, minorities, and younger patients to be hospitalized and diagnosed with AMI or unstable angina (UA). Symptom presentation varied by these same socio-demographic characteristics. Females, minorities, and older patients generally reported more atypical AMI symptoms than males, Whites, and younger patients. Multivariate analyses revealed significant differences in symptoms by diagnostic category after controlling for sociodemographic factors, but no symptom was predictive of only one diagnostic category exclusively.

Conclusions. Diagnostic category and symptom presentation differed by patient sociodemographic characteristics, but no symptoms or combination of symptoms emerged as predictors of specific diagnostic categories. These results illustrate the difficulties in patient care seeking decision making and clinician evaluation of AMI given the ambiguity and variation in symptomatology. Nevertheless, these results may have utility for heightening clinicians' awareness of symptom differences among sociodemographic subgroups and for the design of targeted messages to encourage appropriate care seeking for AMI symptoms.

ACKNOWLEDGMENTS

I wish to acknowledge the contributions made to this research project by other people. Assistance came from many sources, including family, friends, fellow students, teachers, and, most of all, my committee members. In addition, this project is the result of the hard work, talents, and knowledge of the REACT Study team of investigators and staff. I gained more from the experience than can be expressed. I thank you all.

Special acknowledgement and appreciation go to my doctoral dissertation committee. I will always be grateful for their guidance, advice, support, and wisdom. My sincere thanks to James M. Raczynski, Ph.D., dissertation chair, for his wise counsel, advice, and encouragement and, most of all, for keeping me focused on completing the task; Carol E. Cornell, Ph.D., dissertation co-chair, for her unfailingly helpful suggestions and edits and for remaining cheerful and encouraging through numerous readings and re-readings of the document; Vera Bittner, M.D., for providing much needed clinical expertise and for delivering it with humor; James Leeper, Ph.D., for guiding me with great patience through the analysis and interpretation of the data; and last, but not least, to Laura Leviton, Ph.D., who advised, taught, and encouraged me from the beginning.

Other people made important contributions to this work. To those friends to whom I turned for help and advice, thank you. I owe you more than I can ever repay. Your practical and emotional support got me over many hurdles. I could not have succeeded without you.

I thank my family for the love and support that has kept me grounded and enabled me to reach this goal. Special thanks to my parents who taught me the value of hard work and gave me a love of learning. To my children, Eric and Nicole, thank you for loving and sustaining me through it all. Finally, to Jonathan, who put it all in perspective, just by being.

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INTRODUCTION

Statement of the Problem

Chest pain is the symptom most frequently reported in persons diagnosed with acute myocardial infarction (AMI: Dracup & Moser, 1997; Karlson, Herlitz, Pettersson, Ekvall, & Hjalmarson, 1991; Karlson, Sjöland, Währborg, Lindqvist, & Herlitz, 1997; Kudenchuk, Maynard, Martin, Wirkus, & Weaver, 1996) and is a common complaint among patients who present to hospital emergency departments (EDs), occurring in as many as one fifth of all patients (Karlson et al., 1991). Persons with this or other symptoms indicative of AMI generally are encouraged to seek medical treatment quickly, usually by accessing emergency medical services (EMS). Many of these patients will be sent home directly from the ED, but a substantial proportion will be admitted to the hospital for further evaluation. Among these admitted patients, about half (52%) will be diagnosed with AMI or unstable angina (UA; T. H. Lee, Ting, Shammash, Soukup, & Goldman, 1992). The remaining admitted patients will be discharged with some other cardiac condition (13%) or with a noncardiac diagnosis (33%) (T. H. Lee et al., 1992).

People seek health care in response to symptoms they identify as requiring professional assessment, and those who seek emergency care usually are reacting to what they perceive to be a potentially life-threatening situation. However, an individual may not be able to determine correctly which symptoms require emergency treatment. This may result in the patient presenting to the ED with a nonemergency condition, or, conversely, not seeking needed emergency treatment because symptoms are not interpreted as indicating a serious health problem. Delaying care for illnesses such as AMI can have serious repercussions, including a poorer prognosis (Gruppo Italiano per lo Studio della Sopvavvi-venza nell' Infarto [GISSI], 1986; Grines & DeMaria, 1990; Second International Study of Infarct Survival Collaborative Group [ISIS-2], 1988). Likewise, unnecessary use of emergency services has implications for both patients and the health care system, the most obvious being increased costs for nonessential care.

Ideally, people would be able to distinguish symptoms that require medical care quickly from those caused by less serious conditions. Part of the difficulty people experience in determining the need for medical care in response to AMI symptoms may lie in the lack of symptom specificity--chest pain, shortness of breath, and other common symptoms are not exclusive to cardiovascular disease. Differences in the way AMI is manifested may be a factor as well. Symptom presentation for AMI has been found to differ by age, sex, and ethnicity characteristics (Herlitz, Karlson, Richter, Strombom, & Hjalmarson, 1992; Karlson, Herlitz, Hartford, & Hjalmarson, 1993; Kudenchuk et al., 1996; D. Maynard, Beshansky, Griffith, & Selker, 1997). Ambiguity associated with the event appears to be an important factor in delayed care seeking. For example, participants in focus groups conducted as part of the formative research for the Rapid Early Action for Coronary Treatment (REACT) Study reported that they delayed seeking care because of uncertainty regarding the seriousness and the meaning of the symptoms being experienced (Finnegan et al., 2000). The nature of the symptom experience is important, also. Symptoms that are severe and continuous may be more likely to prompt early care seeking (Kenyon, Ketterer, Gheorghiade, & Goldstein, 1991; Sjogren, Erhardt, & Theorell, 1979), while those that are mild or intermittent may encourage delay (Alonzo, 1986; Ell et al., 1994; GISSI, 1995; Schmidt & Borsch, 1989, 1990). Not all studies have found these associations (Hackett & Cassem, 1969; Hofgren et al., 1988; Maynard et al., 1989). Finally, individual psychological, physiological, and sociocultural factors influence the ways in which people perceive, interpret, and attribute symptoms (Pennebaker, 1994), and these processes affect care seeking behaviors.

The seriousness of the problem of delayed care seeking is demonstrated by the approximately 466,000 deaths attributable to coronary heart disease that occur in the United States each year (American Heart Association, 1999). More than half of these deaths occur prior to hospital arrival (American Heart Association, 1997, 1999) and within 1 hr of symptom onset (American Heart Association, 1997). Many of these deaths might have been prevented had the patients received early reperfusion treatment. The problem, then, is how best to encourage people to seek treatment appropriately when they experience symptoms that may signal a heart attack.

To address the problem of patient delay, a number of community intervention trials have been conducted to educate people to seek care early when experiencing symptoms of a heart attack. Several of these studies have shown positive results in at least some aspects of the intervention (Blohm et al., 1992; Eppler, Eisenberg, Schaeffer, Meischke, & Larson, 1994; Herlitz, Karlson, Pettersson, Ekvall, & Hjalmarson, 1991; Mitic & Perkins, 1984; O'Rourke, Thompson, & Ballantyne, 1989; Rustige, Burczyk, Schiele, Werner, & Senges, 1990), while others have been less successful in bringing about the desired behavioral changes (Ho, Eisenberg, Litwin, Schaeffer, & Damon, 1989; Moses et al., 1991). One possible explanation for the limited success of community education interventions may be that too little is known about the symptom experiences of people who present to hospital EDs with possible AMI. Examining patient symptom presentation to the ED may help to clarify the range of symptoms experienced and may reveal meaningful differences in presentation among different population subgroups and diagnostic categories. This information could be important in efforts to design more successful messages for targeted interventions aimed at reducing delays in care seeking. This information could also aid in early clinical decision making by EMS and ED staffs.

Purposes of the Study

The data used in this study were collected as part of a larger study called REACT that was designed to reduce patient delay time in seeking treatment when experiencing symptoms suggestive of a heart attack. Permission to use human subjects was approved under the Institutional Review Board (IRB) of the University of Alabama at Birmingham (Appendix A). The study population consisted of patients who presented to study hospital EDs complaining of chest pain or synonymous terms (e.g., chest pressure, burning, or tightness). The purpose of this study was to determine whether there are differences in diagnostic category and sociodemographic characteristics among these patients. Furthermore, presenting symptoms will be examined to determine whether some symptoms tend to occur together and, if so, whether these symptom patterns are associated with diagnostic group or sociodemographic characteristics. The specific research questions and hypotheses to be examined are specified below.

Research Questions

1. In a population of patients who present to emergency departments with symptoms suggestive of possible AMI, are there significant differences in sociodemographic factors (e.g., sex, age group, and ethnicity) between the following diagnostic groups: (a) patients admitted to the hospital and discharged with a diagnosis of AMI or unstable angina (International Classification of Diseases or ICD codes 410 and 411); (b) patients admitted and later discharged with another cardiac diagnosis (ICD codes 412, 413, 414, 427, 428, 440, and 786.5); (c) patients admitted and discharged with a noncardiac diagnosis; and (d) patients who are released to home?

2. Are there differences between sociodemographic groups in symptom presentation for possible AMI?

3. Controlling for sociodemographic variables, are there significant differences in symptom presentation between diagnostic groups?

4. Are there groups of presenting symptoms that tend to occur together?

5. Do diagnostic and sociodemographic groups differ in their patterns of symptom clusters?

Research Hypotheses

1. Compared with patients in the other diagnostic categories, patients admitted to the hospital and discharged with a diagnosis of AMI or UA will be older, more commonly male, and more often White.

2. Significant differences will be found in symptom presentation between sex, ethnicity, and age groups, with older people, females, and minorities reporting chest

sensations and other symptoms distinct from those reported by younger people, males, and Whites.

3. Controlling for sociodemographic variables, patients admitted and discharged with a diagnosis of ICD codes 410 or 411 will be significantly more likely to present with chest pressure, radiation of pain, diaphoresis, and dyspnea (T. H. Lee et al., 1992) compared with patients in other diagnostic groups.

4. There will be symptoms that tend to occur together (symptom clusters).

5. It is expected that differences in these symptom clusters will emerge between diagnostic and sociodemographic categories. For example, male patients with an AMI or UA diagnosis (ICD codes 410 and 411) will be more likely to present with traditionally recognized cardiac symptom clusters (e.g., a combination of chest pain or pressure with radiation or diaphoresis), compared with women AMI/UA patients and with patients in other diagnostic categories.

REVIEW OF THE LITERATURE AND RESEARCH

Symptoms of AMI

There are a number of symptoms that may indicate a possible heart attack, although no single one is specific to AMI. Further, the characteristics of the symptoms differ among patients and, to some extent, by type of AMI being experienced (Pasternak, Braunwald, & Sobel, 1992). Chest pain, pressure, or discomfort is the most common symptom reported by most AMI patients (Dracup & Moser, 1997; Karlson et al., 1991; Karlson, Sjöland, et al., 1997). The pain or discomfort associated with AMI can range from mild to severe, and in 15 to 20% of cases the event is painless (Pasternak & Braunwald, 1994). In as many as 20% to 60% of nonfatal AMIs, the illness episode is unrecognized by the patient at the time of occurrence, and approximately half of these patients are unable to recall any symptoms at all that they associate with the event (Pasternak et al., 1992). When chest pain is present, it is typically centered in the chest or epigastric area, but it may radiate to the arms or other areas (Pasternak & Braunwald, 1994). Radiation of pain to the arm occurs in 30% (Pasternak & Braunwald, 1994) to 50% of AMI patients (Dracup & Moser, 1997; Goldberg et al., 2000). Pain may also radiate to other parts of the upper body, such as the abdomen, back, neck, and lower jaw and even into the occipital area, but does not occur below the waist (Pasternak & Braunwald, 1994).

Other reported AMI symptoms include diaphoresis, dyspnea, weakness, nausea, vomiting, loss of consciousness or faintness, fatigue, and anxiety (H.-O. Lee, 1997;

Pasternak & Braunwald, 1994). These symptoms may occur alone or in combination with one or more of the others (Pasternak & Braunwald, 1994). Estimates of the number of patients with chest pain who also report diaphoresis range from 40% (Goldberg et al., 2000) to 75% (Dracup & Moser, 1997). An earlier study of REACT patients reported that, among those diagnosed with AMI, arm pain (49%), dyspnea (47%), diaphoresis (40%), and nausea (37%) were commonly reported accompanying symptoms (Goldberg et al., 2000). These also were the most common symptoms reported by the REACT cohort diagnosed with UA, although the order and frequency with which they were reported changed (dyspnea 51%, arm pain 43%, diaphoresis 29%, and nausea 29%). REACT patients diagnosed with AMI reported significantly more arm pain, sweating, nausea, vomiting, and indigestion compared with patients diagnosed with UA. Conversely, UA patients more often experienced neck pain, dizziness, and palpitations. These differences between AMI and UA, however, may not be of clinical significance and thus have been combined for the current analyses.

Although chest pain is the most commonly reported symptom for AMI, it may not carry the highest risk. Karlson, Sjöland, and colleagues (1997) reported that, among patients presenting to the ED with AMI symptoms, chest pain was not an independent risk factor for death, perhaps because chest pain was often found to be noncardiac in origin. The only predictors of mortality were loss of consciousness, acute congestive heart failure, and what the authors referred to as "unspecific" symptoms. Furthermore, the quality of pain appears to be important: pain that is "sharp and stabbing" was found to be predictive of a normal encephalograph (ECG) in one study (T. H. Lee et al., 1985).

Location of the presenting chest pain may be a better predictor of AMI than the pain itself. Everts, Karlson, Wahrborg, Hedner, and Herlitz (1996) had chest pain patients locate their pain by siting it on a grid divided into nine squares and placed over a drawing of a human torso. The grid layout corresponded to the individual's right and left. People with confirmed AMI more often reported pain in the upper right square and in both arms. Left arm pain was reported by about half of all AMI patients compared with slightly more than one third who indicated right arm pain. Compared with the no AMI group, patients diagnosed with a heart attack less often reported pain in the middle left square. Patients with a confirmed AMI also had a significantly higher mean number of regions affected (4.2 versus 3.7, $p < 0.01$), possibly indicating more diffuse symptoms. Diffuseness of symptoms may reflect the tissue involved. Somatic pain may be easier for patients to pinpoint compared with visceral pain, which is more likely to be widespread.

Appraisal and Attribution of Symptoms

Several theoretical models have been developed in an attempt to elucidate factors believed to affect the symptom appraisal and attribution process. Early models presupposed a direct link between physical signs and symptoms and the existence of a disease or condition and further assumed that symptom reporting was directly related to the illness event being experienced. These models also generally assumed that the greater and more severe the symptoms, the more serious the illness (Phillips, Cornell, Raczynski, & Gilliland, 1999). Perceived sensations, however, are not always based on physiological reactions to stimuli nor is there a direct link between a physiological process and symptom perception (Pennebaker, 1982).

As theoretical models became more sophisticated, the focus shifted to how individuals evaluate and label internal states and began to take into account individual differences in symptom appraisal, attribution, and reporting (Phillips et al., 1999). It was recognized that perception and interpretation of symptoms is not a direct cause and effect response to internal stimuli but instead is influenced by individual internal states and characteristics, for example, anxiety and fear, or by external events, such as overwhelming demands for one's attention (Pennebaker, 1982, 1994). Symptoms, according to Pennebaker, are merely "imperfect indicants of physiological processes" (1982, p. 11). These individual psychological processes and other personal characteristics in large part proscribe what symptoms people perceive and report (Pennebaker, 1994) and, therefore, those for which they seek treatment.

More recent theories have focused on the interdependence of individual perceptions, beliefs, and psychological states (Phillips et al., 1999) and how these affect care seeking behavior. Researchers have proposed the self-regulatory theory, which seeks to explain how individuals adapt when confronted by a potential health threat (Cameron, Leventhal, & Leventhal, 1993; H. Leventhal, Meyer, & Nerenz, 1980; H. Leventhal, Diefenbach, & Leventhal, 1992). The theory proposes that illness and care seeking behaviors can be understood as two interrelated processing systems. The first system creates a psychological "objective" representation of the health threat along with coping and evaluation procedures. The "subjective" emotional processing system is responsible for feeling states and for coping strategies and appraisals to manage the emotions generated by the threat (H. Leventhal et al., 1992). Self-regulatory theory proposes that emotional responses, such as anxiety, fear, or anger, occur simultaneously with the cognitive processes that develop in response to the threat to health. Awareness of symptoms can be initiated by internal or external stimuli. Upon becoming aware, the individual then elaborates on these symptoms to create the cognitive representation and emotional response to the perceived threat. These processes are self-regulating in that they guide individuals in the selection and initiation of coping responses. The two processes are parallel and may cycle in and out as the individual reevaluates and makes changes in coping responses as necessary (Figure 1, permission for use in Appendix B).

The objective and subjective processing systems each move through three main stages that are triggered in sequence by the threat to health. The first stage, problem representation, is the period during which the individual uses a set of attributes to identify or specify the problems and what actions need to be taken. Coping responses are generated in the action plan stage when the individual determines a course of action to manage the perceived problem. In the appraisal process stage, personal sets of rules are used to determine whether the response generated in the action stage has been effective. As with the subjective and objective processes, repeated cycling of these stages may occur as the individual generates new hypotheses regarding the illness and initiates and evaluates each response and its consequences. The stages are affected by individual biological and psychological characteristics but also by the sociocultural context in which they occur. The success or failure of the responses to symptoms influences health care seeking behavior (H. Leventhal et al., 1992). Failure of coping responses may decrease patient delay in seeking care. Care seeking delay among REACT patients has been addressed in another paper, however, and will not be addressed here.

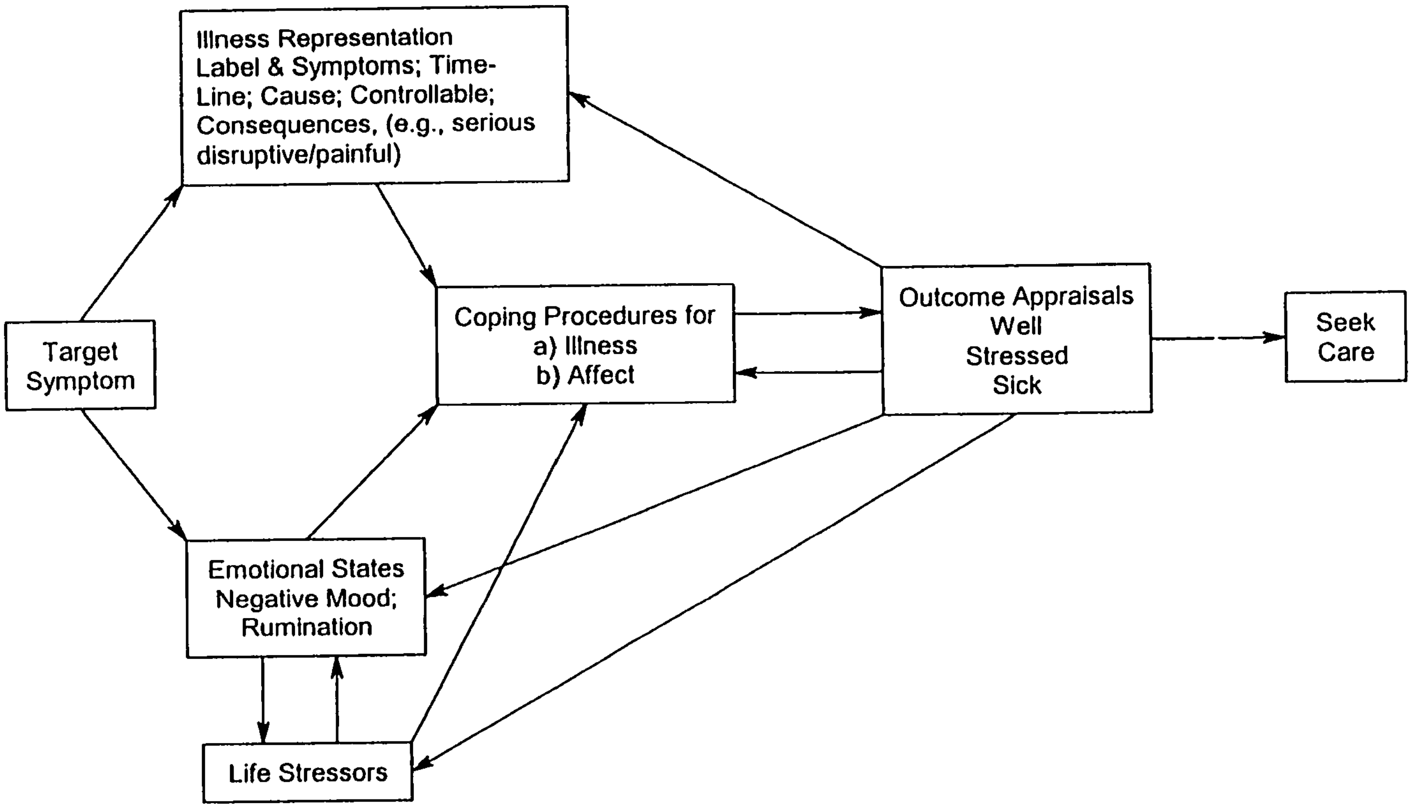

Figure 1. The self-regulatory model of health and illness behavior. *Note.* Adapted from "Symptom representations and affect as determinants of care seeking in a community-dwelling, adult sample population," by L. Cameron, E. A. Leventhal, and H. Leventhal, 1993, *Health Psychology, 12,* 171-179. Adapted with permission (Appendix B).

The attribution of symptoms is an important component in the decision to seek care. The coping response and action plan are likely to differ greatly for symptoms perceived to be life threatening compared with those attributed to a less serious cause. The symptom attribution process itself may be affected by individual experiences and characteristics, such as tolerance of pain, but also may be affected by other factors, such as knowledge of symptoms associated with particular diseases, or more general beliefs or attitudes that may be conditioned by sociocultural or ethnic background. For example, Black and White patients with coronary heart disease have been found to differ in their attribution of symptoms, with Blacks being more likely to ascribe their symptoms to noncardiac causes (Raczynski et al., 1994).

Influence of Symptom Characteristics on Appraisal and Interpretation

People may have difficulty recognizing and attributing AMI-related symptoms in part because the symptoms are variable and not specific to the disease. Some people experience no discernable somatic symptoms at all, the silent MI (Pasternak & Braunwald, 1994), while others report a wide range of symptoms that vary from mild to severe. Other people may experience similar symptoms but have no detectable cardiac disease. There is considerable debate over causes of chest pain in this group of patients, and several mechanisms have been proposed to account for it, including coronary spasms and other cardiac related causes, noncardiac causes such as anxiety or panic disorders, and neural disorders or abnormal pain perception (Cannon, 1997).

AMI symptoms can also be hard to distinguish from those of numerous other, usually more benign, conditions. Chest pain, for example, may result from pulmonary diseases (e.g., pneumonia or bronchitis) or other milder conditions (e.g., indigestion) although the accompanying symptoms, if any, may differ from those of AMI. The nonspecificity and variability of symptoms likely induce many patients to attribute symptoms to nonthreatening causes. This variation and lack of consistency in symptoms of AMI may inhibit people from seeking care.

These factors may also affect care seeking in that individuals attribute the symptoms to other causes, based on previous experiences, and thus do not label them as being serious or in need of emergency care. Pennebaker (1982) proposes that, when individuals are physiologically aroused without explanation as to the cause of the arousal, they will try to label and describe the sensation in terms of available knowledge. This suggests that individuals perceive and label AMI symptoms differently based on their prior experiences. Most people have no prior personal experiences with AMI; their knowledge of AMI is often based on anecdotal reports, which may not coincide with what a particular individual is experiencing.

Individual symptom appraisal and interpretation also includes assessment of the severity of the symptoms being experienced. Perceived seriousness of the symptom has been positively associated with care seeking behavior (Berkanovic, Telesky, & Reeder, 1981). Patients may conclude that pain is related to severity of disease, which results in their being less likely to seek care for what are perceived to be mild and therefore nonlifethreatening symptoms. Schwartz and Keller (1993) conducted a qualitative study of seven AMI patients regarding variables that affected their reporting of pain. More than one fourth believed that the amount of pain they felt was directly associated with the degree of severity of their illness. The authors proposed that the patients felt justified in reporting their symptoms only when the pain was severe, prolonged, or increased in intensity, and, even so, most waited to see if the symptoms would resolve on their own before seeking medical care.

Sociodemographic Characteristics Associated With Symptom Presentation

Symptoms vary greatly among patients presenting to EDs with possible AMI. Differences have been reported not only among individual patients but also in aggregates of patients grouped on sociodemographic and physiological characteristics, such as age, sex, and ethnicity or cultural heritage. These results are discussed below.

Age. Previous research has shown differences in symptom presentation by age or age group. The age divisions used vary among studies, but most researchers subdivide age into two or more mutually exclusive categories. In general, younger patients are more likely than older patients to present with classic AMI symptoms such as chest pain (Ciccone, Allegra, Cochran, Cody, & Roche, 1998; Karlson et al., 1991; Solomon et al., 1989) or neck and arm pain (Everts et al., 1996; Solomon et al., 1989). Most research suggests that older patients report more atypical symptoms (Herlitz et al., 1992; Karlson et al., 1991; Lusiani, Perrone, Pesavento, & Conte, 1994; Solomon et al., 1989), but the evidence is somewhat inconsistent. Solomon et al. (1989) found older patients (≥ 65 years) with a confirmed AMI were more likely to have a history of angina or AMI and were less likely to report with classic AMI symptoms such as chest "pressure," substernal pain, or radiation. Among patients who were not diagnosed with AMI, however, older age was associated with a greater likelihood of reporting "pressure" or pain in the substernal area, and less frequent pain with chest palpation. Other researchers (de Bruyne et al., 1997) also found that older AMI patients were more likely to report "pressure" compared with younger patients. Soloman and colleagues (1989) reported that older patients were more often female and were less likely to have radiation of pain or pain that could be reproduced by changes or by deep breathing. Overall, it was found that clinical features and symptoms that predicted AMI were the same regardless of age category but that the odds ratios were not as strong in older patients (Solomon et al., 1989).

In the REACT cohort of patients with a confirmed AMI, patients aged 55 years or older were significantly less likely to present with arm pain compared with younger AMI patients (Goldberg et al., 2000). Older AMI patients (65 years plus) were least likely to complain of neck pain or sweating. Among UA patients, the 75 years or older age group was least likely to present with arm pain and sweating compared with the youngest group of patients.

Some of the variance in symptom presentation may be explained by an age-related decrease in ability to feel pain or other sensations. Some research suggests that the elderly are less sensitive to "noxious stimulation" (Gibson, Katz, Corran, Farrell, & Helm, 1994, p. 136) because of physiological changes and psychological characteristics, such as stoicism and a reluctance to admit to pain. The authors further suggest that these factors act to raise the pain threshold in the elderly.

Another possible explanation for differences in symptom presentation is that, because the elderly suffer more arthritis or other chronic diseases that require pharmacological treatment, they are more likely to use pain medications or other prescription and nonprescription drugs that may dull physical sensations and thus affect perception. Once pain has been perceived, the elderly describe it in the same terms as younger people (Gibson et al., 1994).

Sex. There appear to be male and female differences in symptom presentation for some cardiac diseases, even after controlling for the later age of onset among females (Karlson et al., 1993; Kudenchuk et al., 1996). On admission, female AMI patients exhibit higher average systolic blood pressure, a higher prevalence of diabetes (D. Maynard et al., 1997; Oka, Fortmann, & Varady, 1996), and a more frequent history of congestive heart failure (D. Maynard et al., 1997) but are less likely to have a previous AMI (Kudenchuk et al., 1996) compared to men. Women with AMI report neck pain, back pain (Everts et al., 1996; Goldberg et al., 1998), dyspnea (Meischke, Larsen, & Eisenberg, 1998), and nausea and vomiting (Goldberg et al., 1998; Meischke et al., 1998) more frequently than men. Men are more often diaphoretic than women (Goldberg et al., 1998; Meischke et al., 1998). Women with confirmed AMI were less likely to report chest pain than men, but the difference disappeared after controlling for age and history of diabetes (Meischke et al., 1998).

Goldberg and colleagues confirmed these results in two different studies (Goldberg et al., 1998, 2000). They found no difference between males and females in frequency of reported chest pain. In the earlier report on data from the REACT study (Goldberg et al., 2000), male AMI patients differed from females only in that women presented more often with vomiting. Among patients with confirmed UA, however, men were significantly less likely than women to report arm, jaw, and neck pain or nausea (Goldberg et al., 2000).

Kudenchuk et al. (1996) also found that women were similar to men in symptom presentation, although chest pain was found to be more transient among women and less often displayed upon arrival to the ED. Moreover, men's chest pain was usually of longer duration than that of women (Oka, Fortmann, & Varady, 1996).

Some symptom differences may lie not so much in symptom perception as in symptom reporting. Women generally report more symptoms than men do (van Wijk & Kolk, 1997). The higher rate of symptoms reported by females has been attributed to various causes but may at least partially result from women being more willing to disclose symptoms. Whether men and women actually differ in symptom perception is still unknown (van Wijk & Kolk, 1997).

Ethnicity. A recent review of the literature on presenting AMI symptoms indicates that Blacks report somewhat different symptoms when compared to Whites (H.-O.Lee, 1997), but not all studies find the differences to be statistically significant (Johnson, Lee, Cook, Rouan, & Goldman, 1993). D. Maynard et al. (1997) found that Black men and women were significantly more likely than Whites to present to the ED with hypertension, shortness of breath, abdominal pain, vomiting, and dizziness but were less likely to complain of angina or to have a history of AMI. It has been reported also that the rate of dyspnea among Blacks is three times that of Whites (Clark, Adams-Campbell, Maw, Bridges, & Kline, 1989). Moreover, only 77% of Blacks presented with classic chest pain compared with 95% of Whites and 91% of Hispanics (Clark et al., 1989). Black females were more likely to have diabetes, with chest pain as the primary symptom and nausea compared with White women, but White women more often reported fainting and a history of congestive heart failure. Raczynski et al. (1994) found that, among patients diagnosed with coronary heart disease, Black men were only about half as likely to report arm pain and numbness as White men. Another study found no significant differences between Blacks and Whites in self-reported or clinical symptoms on presentation (Johnson et al., 1993).

Some of the reported ethnic discrepancy may be explained by differences in perception or reporting of pain. Research in this area suggests that the extent to which an individual feels and expresses pain is conditioned by cultural and social factors (Gibson et al., 1994; McGrath, 1994). In a study of patients with chronic pain, Bates, Edwards, and Anderson (1993) found that ethnic group affiliation was the best predictor of variations in reported pain intensity. The authors concluded that cultural differences in beliefs and attitudes, as well as in emotional and psychological states, affect reported intensity of pain.

Other. Characteristics inherent to individuals or to defined subgroups may affect symptom presentation indirectly by filtering appraisal and reporting of symptoms through psychosocial mechanisms, such as knowledge, beliefs, values, and culture. How or whether a particular symptom is reported may depend on the patient's interpretations of the seriousness of the symptom, which can be affected by numerous factors including previous experiences, beliefs about the cause of the symptoms and knowledge of their possible significance, cultural constraints about acknowledging pain or weakness, and level of somatic awareness (Pennebaker, 1982). Expression of symptoms is also strongly affected by culture (Chung & Singer, 1995).

Turner and Nido (1988) suggest that symptom appraisal, which may affect symptom reporting, varies based on a patient's socioeconomic status. The authors report that patients with lower levels of education show differences in beliefs as to symptoms that require urgent care when compared with more highly educated patients. The presence of a chronic disease may also affect symptom presentation. For example, patients with diabetes mellitus appear to have higher pain thresholds than patients without the disease. The decreased sensitivity to pain may be associated with silent ischemia, which is common in diabetic patients who also have coronary heart disease (Umachandran et al., 1991). All of these factors may affect symptom presentation through various processes.

Reduced reporting of physical symptoms has been associated also with Type A behavior at least among male college students (Hart, 1983). The author suggests that this may be related to Type A's attentional style rather than decreased sensitivity to pain.

Symptom Patterns

Research is limited on symptom patterning at presentation for possible AMI or other cardiovascular diseases. Martin and Pinkerton (1983) reported that patients with congestive heart failure present with symptom clusters that may be helpful in determining the underlying etiology of the disease. In Australian patients, silent cerebral infarction has been associated with a number of psychiatric and behavioral symptoms that grouped into symptom clusters reflecting affective, delusional, and confused states or mood changes indicative of the condition (Nagaratnam & Pathma-Nathan, 1997). Substernal chest pain of 30 min or more duration combined with diaphoresis is strongly suggestive of AMI (Pasternak & Braunwald, 1994). As noted above, T. H. Lee and coworkers (1985) found a combination of characteristics and symptoms (no prior history of angina or MI, sharp or stabbing pain, and pain that was pleuritic, positional, or reproduced by palpation) that was a better predictor of noncardiac diagnosis than any single variable. Herlitz, Bång, Isaksson, and Karlsson (1995) reported that, among chest pain patients who called for an ambulance, the presence of other symptoms, especially a "cold sweat," was associated with an increased rate of AMI.

Previous Studies of ED Patients With Symptoms of AMI

Most studies that have examined characteristics of patients who presented to the ED with complaints suggestive of possible AMI have been conducted by two groups of researchers. Researchers have presented several reports on ED patients using data collected in Göteborg, Sweden (e.g., Herlitz et al., 1992; Herlitz, Bång et al., 1995; Karlson, Herlitz, et al., 1997; Karlson et al., 1991). Most of the U.S. research in this area has been conducted on ED patients presenting to Brigham and Women's Hospital in Boston (T. H. Lee et al., 1985) or from other centers that were part of the multicenter Chest Pain Study (T. H. Lee et al., 1987).

Findings from these studies may be limited by measurement bias. Physicians often consider and accept or discard possible diagnoses based at least partially on patients' symptom descriptions. How the patient describes the symptom may influence the physician's decision to admit or release the patient. This suggests the possibility that patients with symptoms that are atypical or less obviously acute are less likely to be admitted, while the converse is true for patients with more typical or severe symptoms. Therefore, at least part of the variation found between admitted and released patients may be attributable to differences in patient descriptions of the event and ensuing decisions made by the physician regarding testing and admission, decisions that are based, to an unknown extent, on the physician's understanding and interpretation of symptoms the patient is describing. Therefore, the entire population of AMI patients is not likely to be represented in these studies, and the associations reported may be an artifact of symptom reporting and admission decisions. Regardless of these limitations, symptom presentation for possible AMI is an important area of study, and a number of studies have examined this issue among ED patients.

The proportion of patients with symptoms of possible AMI who are admitted to the hospital from the ED varies among hospitals but appears to range from approximately 50% (T. H. Lee et al., 1985, 1992) to as high as 75% (Karlson, Herlitz, et al., 1997). As few as 4% of these patients can be classified as an obvious AMI at time of presentation, although another 20% may have signs and symptoms that suggest a possible infarction, and an additional 35% may be suspect (Karlson et al., 1991). Among patients admitted to the hospital with symptoms of AMI, studies have shown that only about 17% (T. H. Lee et al., 1985) to 22% (Herlitz et al., 1992) will be diagnosed with a heart attack during this hospitalization. Among patients originally admitted with UA, about 15% will go on to develop an infarction (Pasternak et al., 1992).

Some differences related to symptom presentation for possible AMI have been found between admitted and released patients. Although most patients with presumptive AMI report chest pain or some other form of chest discomfort (Gazpoz, Lee, Cook, Weisberg, & Goldman, 1991; Herlitz et al., 1992), the description and quality of the pain varies. The chest pain reported by released patients is more likely to be pleuritic, affected by position changes, or reproduced with palpation of the chest wall and is less likely to be associated with a diagnosis of AMI (T. H. Lee et al., 1985). Patients who are admitted to the hospital are more likely to describe "pressure" type pain and also to report more radiation of pain, diaphoresis, and dyspnea (T. H. Lee et al., 1992) compared to released patients. Patients with chest pressure (T. H. Lee et al., 1985), substernal chest pain, diaphoresis (Cunningham et al., 1989), dyspnea, nausea, vertigo, or syncope (Herlitz, Bång, et al., 1995) also are more likely to be diagnosed with AMI, which may help to account for the higher admission rate of people with these symptoms.

The proportion of males and females presenting with possible AMI symptoms is roughly equivalent, with women accounting for about 45% (Karlson et al., 1991, 1993) to 50% of cases (Cunningham et al., 1989). Among patients who are subsequently diagnosed with AMI, women and men are about equally as likely to be hospitalized; however, among those not diagnosed with an infarction or UA, more men than women are admitted (Cunningham et al., 1989). The authors suggest that this difference is the result of more conservative treatment of male chest pain patients by physicians.

Patients released to home from the ED are younger, more often female, and less likely to have a history of coronary vascular disease compared with admitted AMI patients (Karlson, Wiklund, Bengston, & Herlitz, 1994a). Older patients are more likely to be admitted to the hospital and to a coronary care unit (CCU), perhaps because they are diagnosed more often with an AMI (Solomon et al., 1989). In general, discharged patients have a good short-term prognosis (Herlitz, Karlson, Wiklund, & Bengtson, 1995) with the exception of patients with a history of heart disease (Karlson et al., 1994a). Released patients with a history of ischemic heart disease are more similar to admitted AMI patients in age and cardiovascular disease (CVD) history than they are to other released patients (Karlson et al., 1994a). Patients with a history of coronary artery disease tend to have a poorer survival regardless of admission status (T. H. Lee et al., 1992).

Among admitted patients, those who are diagnosed with AMI have a greater 1-year mortality than do patients with other diagnoses (Karlson, Wiklund, Bengtson, & Herlitz, 1994b). In this study, however, 34% of non-AMI patients were readmitted within 1 year, and the percentage of patients with a non-AMI diagnosis who were readmitted did not differ significantly from that of patients diagnosed with AMI at the index hospitalization.

One study reported that Blacks who presented to EDs with chest pain were significantly less likely to be hospitalized compared with Whites (Johnson et al., 1993). Nevertheless, once admitted, Blacks and Whites were equally likely to be sent to a CCU and to have a cardiac catheterization performed. Blacks who were admitted had significantly less severe coronary artery disease (CAD) compared with Whites and lower rates of coronary artery bypass surgery (Johnson et al., 1993).

Summary

The studies reviewed showed that the symptoms of AMI are diverse and that symptom presentation differs among some demographic subgroups or by diagnostic category. Symptom presentation is affected by differences in the appraisal and reporting of symptoms, which are themselves influenced by sociocultural and idiosyncratic psychological and biophysical characteristics. Still, the majority of AMI or presumptive AMI patients present with chest pain or discomfort, which may be variously described as pain, pressure, tightness, or burning, among other descriptors. Other commonly reported symptoms of AMI include radiation of pain to the arms or other upper body extremities, diaphoresis, dyspnea, and nausea or vomiting. Symptoms, such as indigestion, weakness, and palpitations, are reported less often. Sharp, stabbing pain is predictive of a non-AMI diagnosis, and patients presenting with this type of pain are more likely to be released from the ED than are patients who describe their chest pain using other terminology. Pressuretype pain is the symptom most predictive of AMI, although a combination of symptoms appears to increase the likelihood of this diagnosis. Certain specific combinations of symptoms, such as chest pain or pressure with diaphoresis, may be an ever better predictor of AMI. Notwithstanding, many AMI patients experience only minor symptoms or have no discernable symptoms at all (Pasternak et al., 1992). The variability and nonspecificity of the disease manifestation probably contributes to the difficulty people have in identifying, attributing, and taking action when experiencing symptoms of an AMI.

Several studies have examined differences among patients who presented to the ED with signs and symptoms of AMI. Based on the available evidence, it appears that older people, women, and minorities more often present with atypical cardiac symptoms compared with younger people, males, and Whites. Other characteristics that have been found to influence symptom presentation include cultural heritage, socioeconomic status, and medical history. Medical history has been associated with differences in both symptom presentation and outcome. Patients with a history of coronary disease have higher rates of morbidity and mortality compared with patients without this diagnosis, even among those who present with mild symptoms and are released to home from the ED.

Although several studies have reported on characteristics of ED patients, few studies have focused on differences and interactions among symptom presentation, sociodemographic characteristics, admission status, and diagnostic categories. Identifying and clarifying these differences may aid in developing public health campaigns targeted to high-risk groups and designed to educate people on the need to seek care appropriately if they experience symptoms that may indicate a heart attack.

METHODOLOGY

Research Design

The data used for this study were from the larger dataset collected as part of the REACT Study, a multicenter community intervention trial that was funded by the National Heart, Lung, and Blood Institute. Five university centers participated in the study: the University of Alabama at Birmingham, the University of Massachusetts Medical School, the University of Minnesota, University of Texas Health Science Center at Houston, and the University of Washington-Oregon Health Sciences University. The New England Research Center (NERI) served as coordinating center for the study. The REACT study used an experimental design in which 10 matched, homogeneous pairs of communities were randomized so that one community in each pair received treatment and the other served as the comparison community. The research and statistical design for the REACT project was detailed previously (Feldman et al., 1998; Simons-Morton et al., 1998). Field centers selected communities matched on characteristics believed to be relevant to the study, primarily population size and sociodemographic features. The study field centers, however, were selected in part because of geographic distribution to increase heterogeneity and thus generalizability of the study results. Studywide, communities were selected to ensure adequate samples of minority groups, specifically Blacks and Hispanics. Each of the five field centers selected was responsible for project activities in four communities, two of which were assigned to intervention and two were control communities.

Data were collected on all eligible patients presenting to 43 project hospital EDs in the 20 communities. In each community, patients from all hospitals that captured 10% or more of the total AMI population inside the designated project area were included in the study population. Project area was defined by a list of zip codes that more or less encompassed municipal or county boundaries. ED nursing staff and physicians were trained prior to study initiation to ask patients two questions in a consistent manner to elicit information on symptoms and delay time from onset of symptoms:

1. What are the symptoms that brought you here today?

2. When did these symptoms start?

Refresher training of ED staff was conducted during the intervention phase of the study. Despite efforts at quality control in the ascertainment and recording of symptoms, it is not possible to estimate the proportion of reporting error introduced into the measurement. Some measurement error may arise from ED staff imposing stereotypical views of symptoms on particular age, sex, or racial and ethnic groups. Nevertheless, there is no evidence to show that this occurred although it is impossible to rule out this potential threat to validity.

Information was collected from ED and in-hospital medical records by trained data abstractors. Baseline data collected between December 1, 1995, and March 31, 1996, were used in this study. The data abstracted consisted of basic demographic data, discharge diagnosis or ED clinical impression, symptoms reported by the patient (from both nurses' and physicians' notes), time the symptoms started or their duration, ED arrival time, the first pulse and blood pressure taken in the ED, and whether the patient was admitted to the hospital.

Sample Selection

The sample included patients from communities located in 10 states: Alabama, Louisiana, Massachusetts, Minnesota, North Dakota, Oregon, South Dakota, Texas, Washington, and Wisconsin. Patients who presented to the ED in study hospitals with a complaint of chest pain, pressure, tightness, burning, or other synonym suggestive of AMI were eligible for the study. Other eligibility criteria included residence in one of the study communities (as designated by zip code) and being age 30 years or older. Patients with obvious trauma or who were institutionalized at time of presentation were excluded. Emergency department logs were screened, and all eligible patients were included in the sample. Some project hospitals did not record the presenting complaint on the ED log, and in these hospitals admitting diagnoses were used to determine basic eligibility. However, chest pain and synonymous terms were often recorded as the admitting diagnosis rather than a more formal diagnosis or ICD code designation. Therefore, virtually all patients were recorded as presenting with chest pain or another term indicating chest discomfort or sensation.

The sample for this study was comprised of patients who presented to project hospital EDs during the 4 months of baseline data collection, December 1, 1995, through March 31, 1996. Medical record data were abstracted for all eligible admitted patients. Initially, ED charts were abstracted on almost all released patients as well. Later, because of time and workload constraints, a sampling fraction was used to select a subset of released patients for whom ED medical chart data were abstracted. The sampling fractions were specific to hospitals and also were decreased again during the course of the study. Nevertheless, ED records for released patients were randomly selected for abstraction, and there is no evidence of systematic bias introduced through the sampling procedure. Studywide, 51.6% of all patients were released to home, but these patients constituted only 35% of the total baseline sample. The final database includes data on 2,168 released and 4,086 admitted patients for a total sample size of 6,254 individuals.

Data Collection Methods

Data were directly entered into laptop computers by data collectors, using data entry screens designed for this study by the NERI. Data collectors received training in chart abstraction and data entry and were required to abstract two medical charts at 90% accuracy to be certified and allowed to collect data. Quality control measures were implemented such that data collectors were periodically tested for accuracy, and those scoring below 90% were retrained. Data abstractors who scored less than 80% were replaced or recertified before they were allowed to abstract additional data. Data were transmitted electronically to NERI, where they were scrutinized and cleaned, and possible data errors were returned to the local center for verification or clarification.

Analysis of Data

Frequency distributions were used to present descriptive statistics for the sample. Age was grouped into 10-year age groups (30 to 39 years, 40 to 49 years, 50 to 59 years, 60 to 69 years, 70 to 79 years, and 80 or more years). Race was categorized as White, Black, Hispanic, or Other based on the information reported in hospital charts. Patients in the baseline dataset were subdivided into four groups for all analyses as follows:

1. Group 1 included all patients admitted and subsequently diagnosed with AMI or UA, ICD codes 410 and 411, referred to as AMI UA.

2. Group 2 contained patients admitted and diagnosed with some other cardiac condition (ICD codes 412, 413, 414, 427, 428, 440, and 786.5), called Other Cardiac.

3. Group 3 included patients admitted and diagnosed with noncardiac diseases or conditions (all other ICD codes), labeled Other.

4. Group 4 included patients who were released to home from the ED and are referred to as Released.

Univariate analyses (chi-square statistics) were used to test for significant differences in selected sociodemographic variables (sex, ethnicity, and age group) among the four patient diagnostic groups. Log-linear analysis was used to investigate higher order interactive effects, as indicated by the chi-square analysis. Subgroup analysis was used as necessary to help to interpret results. All tests of significance were two-tailed. The probability value for statistical significance was set ($p \leq 0.05$) for analysis of diagnostic group and sociodemographic differences and ($p \leq 0.002$) for analysis of symptoms. The Bonferroni Correction was used to control for Type I error and inflation of alpha.

The chi-square statistic and log-linear and subgroup analyses as indicated were used also to test for differences between presenting symptoms and sociodemographic characteristics. Presenting symptoms were abstracted from patient medical records as recorded in the ED physicians' and ED nurses' notes. All symptoms reported by the patient and recorded by either the ED physician or nurse were recorded and coded as 1 (*yes*), the symptom was reported by the patient; or 2 (*no*), the patient denied the symptom; or -8, (*not recorded*) the symptom was not recorded as present but was not explicitly denied.

Symptoms recorded by ED physicians and nurses were coded separately, but the percentages for particular symptoms were similar. Therefore, for these analyses, a symptom was considered present if reported by either the physician or the nurse. Because most symptoms were only reported if present, the 2 (*no*) and -8 (*not recorded*) categories were combined and recoded to equal zero, and symptoms were categorized as reported or not reported.

Logistic regression models were used to test relations between presenting symptoms and diagnostic category, controlling for sex, ethnicity, age group, and community. Because diagnostic category was a four-level outcome variable, logistic regression including all four diagnostic groups into one model would have been extremely complex. Determining the relationship between each of the outcome levels while simultaneously controlling for the various demographic variables, which, except for sex, also have multiple levels, could not produce an interpretable outcome. The models could show that differences in symptom presentation existed among the diagnostic groups overall but could not show differences between specific groups (e.g., odds ratios and confidence intervals could not be calculated). In SAS, the Generalized Logits procedure (PROC CATMOD) is designed to analyze polytomous outcome variables but could not be used for these analyses because it was necessary to control for several multilevel demographic variables in the analysis. Instead of using a four-level outcome variable, analyses were performed on diagnostic groups in pairs, analyzing all possible combinations of groupings. This simplified the analysis and interpretation of the regression models.

Two separate sets of logistic regression analyses were performed using SAS PROC Logistic. In the analyses, each symptom was fitted to a separate logistic regression model to determine which symptoms predicted diagnostic category. Dummy variables were defined for ethnicity, age group, and community. Adjusted odds ratios (AOR) and 95% confidence intervals (CI) were computed. The first set of logistic regression analyses compared admitted to released patients, AMI/UA to all other patients, and other cardiac patients with all others. The second set of analyses compared each diagnostic category with each of the other groups.

After examining the individual predictive value of each symptom, data reduction was attempted by combining symptoms that had some apparent underlying physiological similarity. All chest symptoms were combined into one new variable, *chest sensations*. Arm pain or numbness, jaw pain, and neck pain were combined to create *radiation*. Other symptoms combined were nausea and vomiting, dizziness and unconsciousness, and abdominal pain and indigestion. These combined variables were used in a separate analysis to determine if they predicted diagnostic group status.

The final two hypotheses examined whether specific symptoms clustered or grouped together and, if so, whether the symptom clusters differed between diagnostic categories and sociodemographic groups. Factor analysis with varimax rotation was used to create factor scores to determine if there were underlying associations among the 21 symptoms. The frequency distributions of item combinations from the factors were examined to determine if they could be used as better predictors of diagnostic group outcome.

RESULTS

Characteristics of the Sample Population

The characteristics of individuals living within the 20 REACT communities are summarized in Table 1. Community size varied from 55,777 to 238,912 persons. Annual median household income ranged from a low of $15,890 in Brownsville, Texas, to a high of $36,268 in Shoreline, Washington. The lowest and highest median ages of the community populations were also reported in Texas (25.9 years in Brownsville and Laredo) and Shoreline, Washington (36.2 years). The community with the lowest percentage of male headed households (47%) was in Texas also, while the highest was in Alabama (51%). Brownsville, Texas also had the distinction of having the lowest educational level of all study communities, and only 45% of the population had completed high school compared to 90% in one Oregon community. Texas communities were the most diverse ethnically, having the lowest percentage of Whites and the highest percentage of both Blacks and Hispanics across the entire 20 communities. Shoreline, Washington had the highest percentage of community residents classified as "Other" ethnicity. Almost 98% of the residents in Pitsville/Dalton, Massachusetts, were White, the highest percentage in any of the study communities.

The baseline sample included data collected from ED medical charts on 6,254 patients who presented to study hospital EDs (Table 2). Information on ethnicity was missing in the medical charts for about 13% of the cases. Of patients with missing ethnicity, 44% were from the two communities in the Northwestern United States where the

Table 1

Characteristics of REACT Communities

Project site	Study community	1990 population	Household median income	Household % male	Median age (years)	Education (% HS graduate)	White	Black	Hispanic	Other
AL	Anniston.	115,432	$28,340.00	51.4	33.6	67.4	79.2	18.4	1.0	1.4
	Opelika	89,714	$32,596.00	47.6	26.8	73.2	74.1	23.3	0.6	2.0
	Huntsville	238,912	$39,264.00	49.2	31.5	80.2	77.1	20.1	1.3	2.2
	Tuscaloosa	154,131	$30,135.00	48.1	31.5	69.6	72.2	26.0	0.6	1.2
MA	Worcester	169,759	$28,955.00	47.6	31.8	74.7	87.1	4.5	9.6	8.4
	Lowell	103,439	$29,351.00	48.7	29.4	67.9	81.1	2.4	10.1	6.6
	Pittsville/Dalton	55,777	$33,253.00	47.8	35.7	82.0	97.7	1.7	0.8	1.0
	Westfield and W. Springfield	65,909	$32,842.00	47.9	34.3	79.9	97.1	1.2	2.3	2.2
MN	Sioux Falls, SD	123,809	$29,764.00	48.1	31.5	83.2	97.3	0.6	0.5	1.9
	Fargo, ND Moorhead, MN	153,296	$26,551.00	49.2	29.9	85.1	97.4	0.3	1.1	1.8
	La Crosse, WI	97,904	$26,857.00	48.0	31.1	82.5	96.1	0.5	0.7	3.3
	Eau Claire, WI	137,543	$25,876.00	48.4	31.5	79.5	97.3	0.3	0.4	2.7

Table 1 (Continued)

Project site	Study community	1990 population	Household median income	Household % male	Median age (years)	Education (% HS graduate)	White	Black	Hispanic	Other
TX	Brownsville	98,962	$15,890.00	47.2	25.9	45.2	9.2	0.2	90.1	0.5
	Laredo	122,899	$18,345.00	47.8	25.9	77.1	5.4	0.1	93.9	0.6
	Tyler	75,450	$23,611.00	47.0	32.5	77.1	62.1	28.2	8.9	0.8
	Lake Charles, LA	70,580	$21,225.00	47.2	32.1	69.4	56.6	41.6	1.1	0.7
WA/ OR	Eugene, OR	112,669	$25,369.00	48.1	32.2	88.6	93.4	1.3	2.7	5.3
	W. Portland, OR	87,594	$36,253.00	48.6	31.2	90.6	90.0	0.9	3.5	9.2
	Olympia, WA	69,156	$28,686.00	47.4	34.2	88.3	90.5	2.1	3.1	7.4
	Shoreline, WA	126,647	$36,258.00	48.1	36.2	89.3	86.0	2.2	2.7	11.7
	Community mean		$28,844.00	48.1	31.8	67.6	79.1	8.1	10.9	3.9
	US population mean		$29,943.00	48.8	32.8	77.6	80.3	12.0	8.9	4.6

Note. Some categories may total to more than 100% due to rounding. Persons of Hispanic descent may be of any race, making some race categories total to more than 100%. Education, high school (HS) graduate % ≥ 25 years. REACT = Rapid Early Action for Coronary Treatment.

Table 2

Demographic Characteristics of the Sample

Characteristic	%	(*n*)
Sex		
Male	51.5	(2,759)
Female	48.5	(2,599)
Race and ethnicity		
White	76.0	(4,071)
Black	12.7	(678)
Hispanic	11.4	(609)
Age in years		
30 - 39	11.6	(621)
40 - 49	17.7	(948)
50 - 59	18.0	(966)
60 - 69	19.0	(1,016)
70 - 79	21.0	(1,127)
80 or more	12.7	(678)
Marital status		
Married	60.5	(3,062)
Cohabiting	0.3	(16)
Single	10.9	(554)
Divorced or separated	10.1	(509)
Widowed	18.2	(919)
Employment status		
Employed	35.6	(1,589)
Retired	39.8	(1,775)

Table 2 (Continued)

Characteristic	%	(*n*)
Employment status (continued)		
Disabled	7.0	(313)
Unemployed	12.4	(552)
Homemaker	5.2	(233)
Diagnostic Group		
AMI UA	28.5	(1,527)
Other cardiac	32.3	(1,732)
Other	5.2	(279)
Released to home	34.0	(1,820)
Baseline sample (total)	100.0	(6,254)
Baseline sample (final)	85.6	(5,358)

Note. Age was not recorded for 2 people; marital status was not recorded for 298 people; employment status was not recorded for 896 people; AMI = acute myocardial infarction; UA = unstable angina.

hospitals did not routinely record ethnicity. Only 1.1% (n = 60) of patients with reported ethnicity were designated as being from groups other than White American, Black, or Hispanic American. Demographic characteristics were compared for patients with and without an ethnicity designation to determine if significant differences existed between the groups. The analyses revealed no significance differences for age, sex, or marital status between patients with and without recorded ethnicity. There were, however, significant differences by employment status. Patients with ethnicity not reported were more likely to be employed and were less often disabled, unemployed, or homemakers compared to patients with reported ethnicity. It is likely that these differences reflect demographic and socioeconomic characteristics of the Northwestern U.S. population.

Therefore, all patients with ethnicity not recorded or who were reported as other than White, Black, or Hispanic were dropped from further analyses. This resulted in an overall sample inclusion rate for these analyses of 86% (N = 5,358) of the total baseline sample.

The final sample used for this report was 76% White, 13% Black, and 11% Hispanic. Women comprised almost half of all cases. Approximately 80% of males and 72% of females were White. Most patients were married or living in marriage-like relationships. Employment status was missing from hospital medical charts for 17% of the cases. Among those with recorded employment status, about 40% were retired, reflecting the older age of the sample. Almost 53% were age 60 years or older. Most patients who were admitted to a hospital were diagnosed with a cardiac condition. Overall, almost 29% of patients were diagnosed with AMI/UA and 32% with an Other Cardiac disease. Only 5% were diagnosed with Other disease. The 34% of patients released to home represents only those patients for whom chart data were collected and not the entire subset of released patients.

Sociodemographic Differences Among Diagnostic Groups

Hypothesis 1 addressed sociodemographic differences in diagnostic group assignment and predicted that patients diagnosed with AMI/UA would more often be male, White, and older compared with women, minorities, and younger patients. Table 3 shows each diagnostic category broken down by age group, ethnicity, and sex. In chi-square analysis, there were significant differences in diagnostic group assignment based on sex (Figure 2). Males were significantly more likely than females to be admitted to the hospital ($p \leq 0.001$) and, once admitted, were more often diagnosed with AMI/UA

Table 3

Diagnostic Category by 10-year Age Group, Sex, and Ethinicity

Diagnostic category	10-Year age group											
	Ages 30 - 39 years		Ages 40 - 49 years		Ages 50 - 59 years		Ages 60 - 69 years		Ages 70 - 79 years		Ages 80 + years	
	%	(*n*)	%	(*n*)	%	(*n*)	%	(*n*)	%	(*n*)	%	(*n*)
AMI/UA												
White	87.5	(21)	84.0	(121)	83.6	(235)	84.9	(325)	88.1	(376)	88.1	(236)
Male	76.2	(16)	81.8	(99)	74.5	(175)	69.2	(225)	58.0	(218)	42.0	(99)
Female	23.8	(5)	18.2	(22)	25.5	(60)	30.8	(100)	42.0	(158)	58.1	(137)
Black	4.2	(1)	9.7	(14)	6.4	(18)	3.7	(14)	3.5	(15)	4.5	(12)
Male	100.0	(1)	71.4	(10)	55.6	(10)	42.9	(6)	46.7	(7)	16.7	(2)
Female	0	0	28.6	(4)	44.4	(8)	57.1	(8)	53.3	(8)	83.3	(10)
Hispanic	8.3	(2)	6.3	(9)	10.0	(28)	11.5	(44)	8.4	(36)	7.5	(20)
Male	100.0	(2)	77.8	(7)	75.0	(21)	54.6	(24)	55.6	(20)	35.0	(7)
Female	0	0	22.2	(2)	25.0	(7)	45.5	(20)	44.4	(16)	65.0	(13)
Other cardiac												
White	66.0	(64)	78.1	(243)	74.5	(239)	83.6	(295)	83.3	(348)	86.6	(200)
Male	60.9	(39)	60.9	(148)	56.9	(136)	52.2	(154)	42.2	(147)	35.0	(70)
Female	39.0	(25)	39.1	(95)	43.1	(103)	47.8	(141)	57.8	(201)	65.0	(130)

Table 3 (Continued)

Diagnostic category	10-Year age group											
	Ages 30 - 39 years		Ages 40 - 49 years		Ages 50 - 59 years		Ages 60 - 69 years		Ages 70 - 79 years		Ages 80 + years	
	%	(*n*)	%	(*n*)	%	(*n*)	%	(*n*)	%	(*n*)	%	(*n*)
Other cardiac												
Black	22.7	(22)	16.4	(51)	17.5	(56)	9.4	(33)	8.6	(36)	7.8	(18)
Male	40.9	(9)	47.1	(24)	35.7	(20)	48.5	(16)	36.1	(13)	27.8	(5)
Female	59.1	(13)	52.9	(27)	64.3	(36)	51.5	(17)	63.9	(23)	72.2	(13)
Hispanic	11.3	(11)	5.5	(17)	8.1	(26)	7.1	(25)	8.1	(34)	5.6	(13)
Male	63.6	(7)	64.7	(11)	46.2	(12)	36.0	(9)	55.9	(19)	53.9	(7)
Female	36.4	(4)	35.3	(6)	53.9	(14)	64.0	(16)	44.1	(15)	46.2	(6)
Other												
White	50.0	(16)	63.3	(38)	74.5	(38)	76.8	(43)	81.0	(47)	77.3	(17)
Male	37.5	(6)	57.9	(22)	47.4	(18)	60.5	(26)	48.9	(23)	47.1	(8)
Female	62.5	(10)	42.1	(16)	52.6	(20)	39.5	(5)	51.1	(24)	52.9	(9)
Black	37.5	(12)	25.0	(15)	15.7	(8)	12.5	(7)	13.8	(8)	22.7	(5)
Male	41.7	(5)	46.7	(7)	50.0	(4)	42.9	(3)	75.0	(6)	40.0	(2)
Female	58.3	(7)	53.3	(8)	50.0	(4)	57.1	(4)	25.0	(2)	60.0	(3)
Hispanic	12.5	(4)	11.7	(7)	9.8	(5)	10.7	(6)	5.2	(3)	0	0
Male	75.0	(3)	42.9	(3)	20.0	(1)	33.3	(2)	33.3	(1)	0	0

Table 3 (Continued)

Diagnostic category	10-Year age group											
	Ages 30 - 39 years		Ages 40 - 49 years		Ages 50 - 59 years		Ages 60 - 69 years		Ages 70 - 79 years		Ages 80 + years	
	%	(*N*)	%	(*N*)	%	(*N*)	%	(*N*)	%	(*N*)	%	(*N*)
Female	25.0	(1)	57.1	(4)	(4)	66.7	(4)	66.7	(2)	0	0	0
Released												
White	56.4	(264)	60.3	(261)	67.7	(212)	65.2	(146)	73.7	(165)	75.8	(119)
Male	54.2	(143)	49.0	(128)	54.3	(115)	41.8	(61)	48.5	(80)	40.3	(48)
Female	45.8	(121)	51.0	(133)	45.8	(97)	58.2	(85)	51.5	(85)	59.7	(71)
Black	26.7	(125)	236	(102)	15.3	(48)	13.0	(29)	7.1	(16)	8.3	(13)
Male	32.8	(41)	35.3	(36)	37.5	(18)	48.3	(14)	37.5	(6)	30.8	(4)
Female	67.2	(84)	64.7	(66)	62.5	(30)	51.7	(15)	62.5	(10)	69.2	(9)
Hispanic	16.9	(79)	16.2	(70)	16.9	(53)	21.9	(49)	19.2	(43)	15.9	(25)
Male	41.8	(33)	44.3	(31)	47.2	(25)	30.6	(15)	39.5	(17)	36.0	(9)
Female	58.2	(46)	55.7	(39)	52.8	(28)	69.4	(34)	60.5	(26)	64.0	(16)

Note. AMI/UA ICD codes = 410, 411; Other Cardiac ICD codes = 412, 413, 427, 428, 786.5; Other = all other diagnoses (e.g., ICD codes); Released = released to home from the emergency department. AMI = acute myocardial infarction; UA = unstable angina; ICD = International Classification of Diseases.

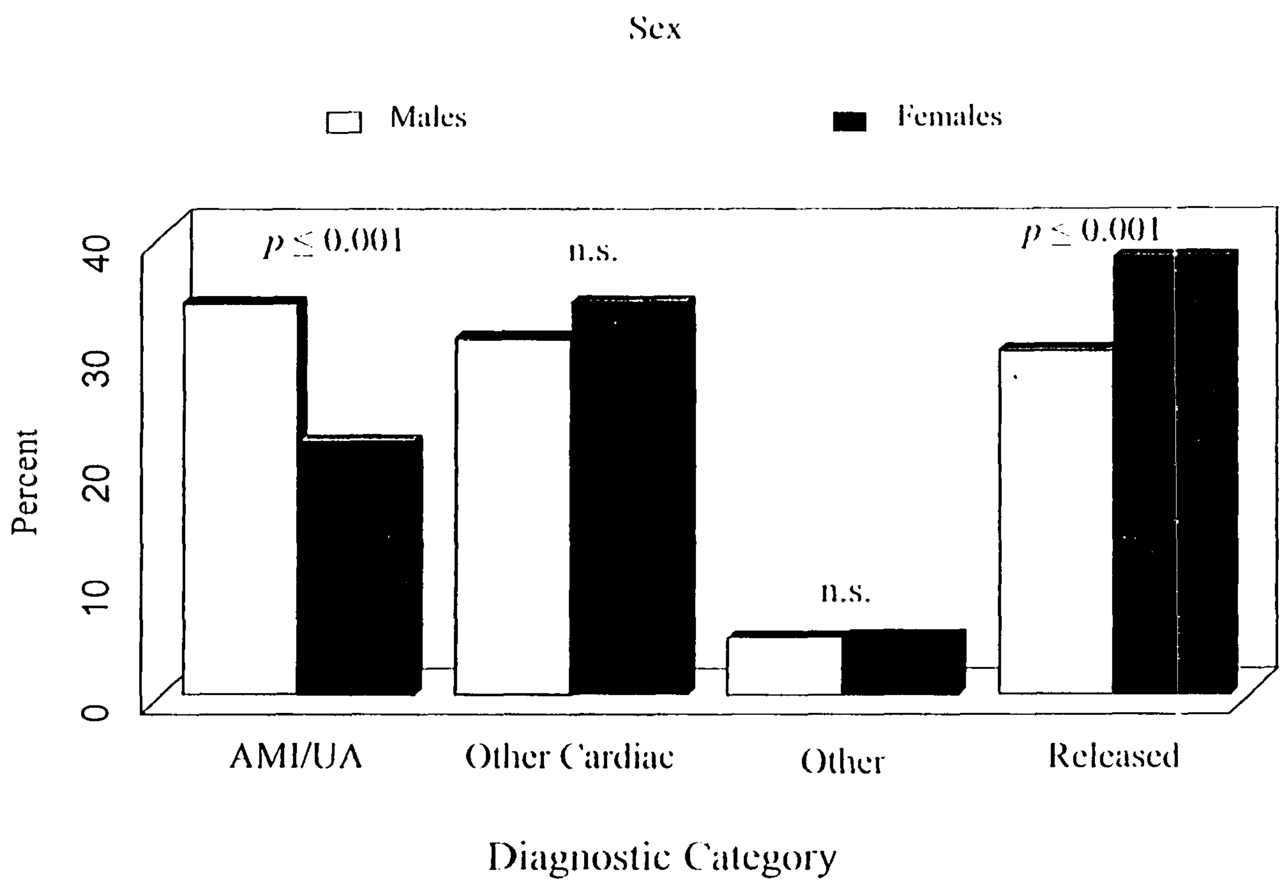

Figure 2. Diagnostic category by sex. AMI = acute myocardial infarction; UA = unstable angina.

($p \leq 0.001$). There were no statistically significant differences between men and women diagnosed with Other Cardiac disease or Other in-hospital diagnosis.

Statistically significant differences in the diagnostic group were found based on ethnicity (Figure 3). White patients were more likely than Black and Hispanic patients to be admitted to the hospital ($p \leq 0.001$) and, once hospitalized, were more often diagnosed with AMI/UA ($p \leq 0.001$). When admitted, Black patients were more likely than the other two groups to receive an Other (noncardiac) diagnosis ($p \leq 0.001$). Compared to Whites or Blacks, Hispanics were less frequently diagnosed with a non-AMI/UA cardiac condition ($p \leq 0.001$).

Diagnostic group assignment differed significantly by 10-year age group as well ($p \leq 0.001$), with higher rates of AMI/UA and Other Cardiac diagnoses among older patients (Figure 4). There was an increase in the rate of diagnosed AMI/UA with each 10-year increment until 60 years of age, after which the differences between age groups leveled off, only to increase slightly among the oldest patients. Patients less than 40 years old were less likely to be diagnosed with Other Cardiac disease (non-AMI/UA) and were more often sent home from the ED.

Log-linear analysis was used to test three-way interactions between diagnostic groups and the sociodemographic variables. The analysis was restricted to three-way analysis because of the difficulty of interpreting higher order interactions and also because the sample was not sufficiently large enough to allow these analyzes given the number of cells involved (4 X 2 X 3 X 6 = 144). The analysis revealed a three-way interaction between diagnostic group, sex and age ($p \leq 0.001$). Separate chi-square analysis was performed to examine the interactive effect.

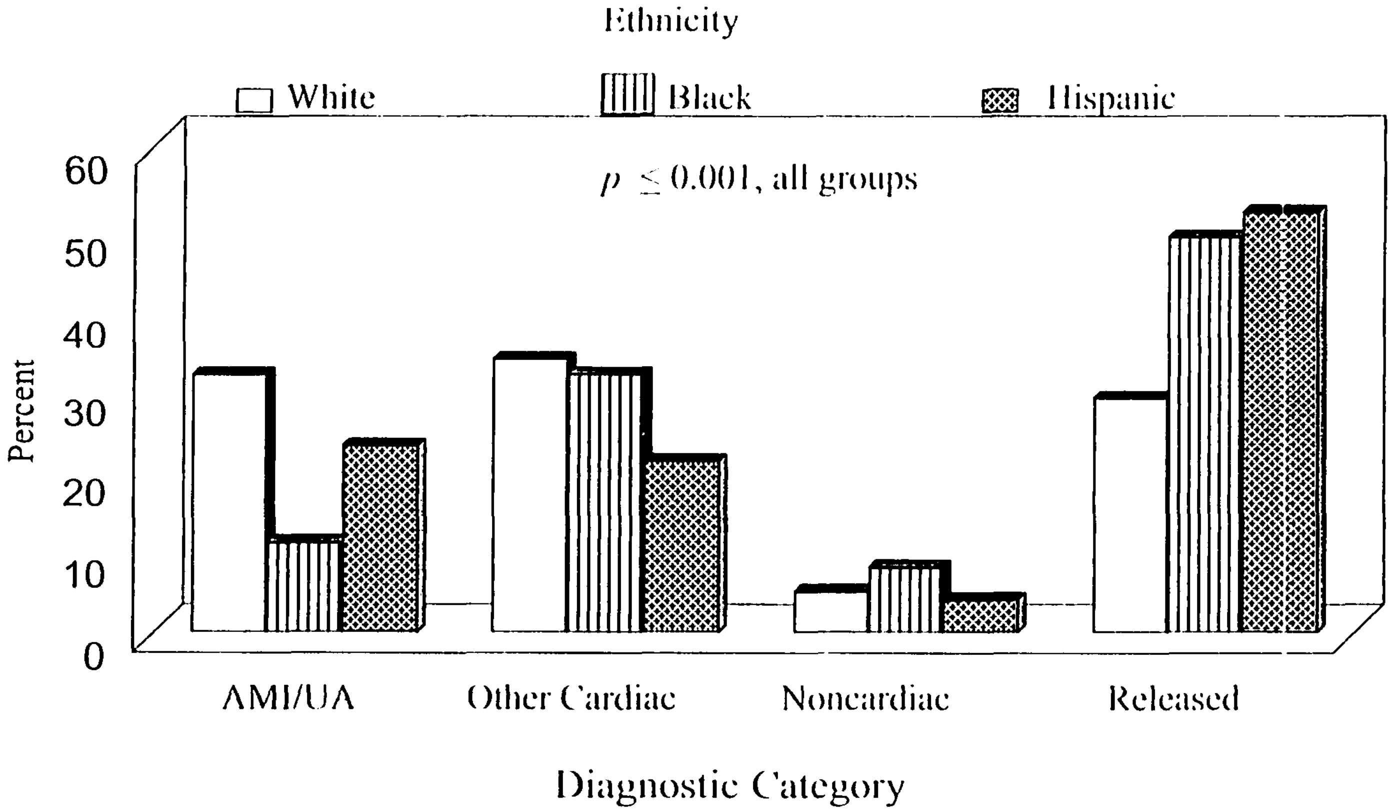

Figure 3. Diagnostic group by ethnicity. AMI = acute myocardial infarction; UA = unstable angina.

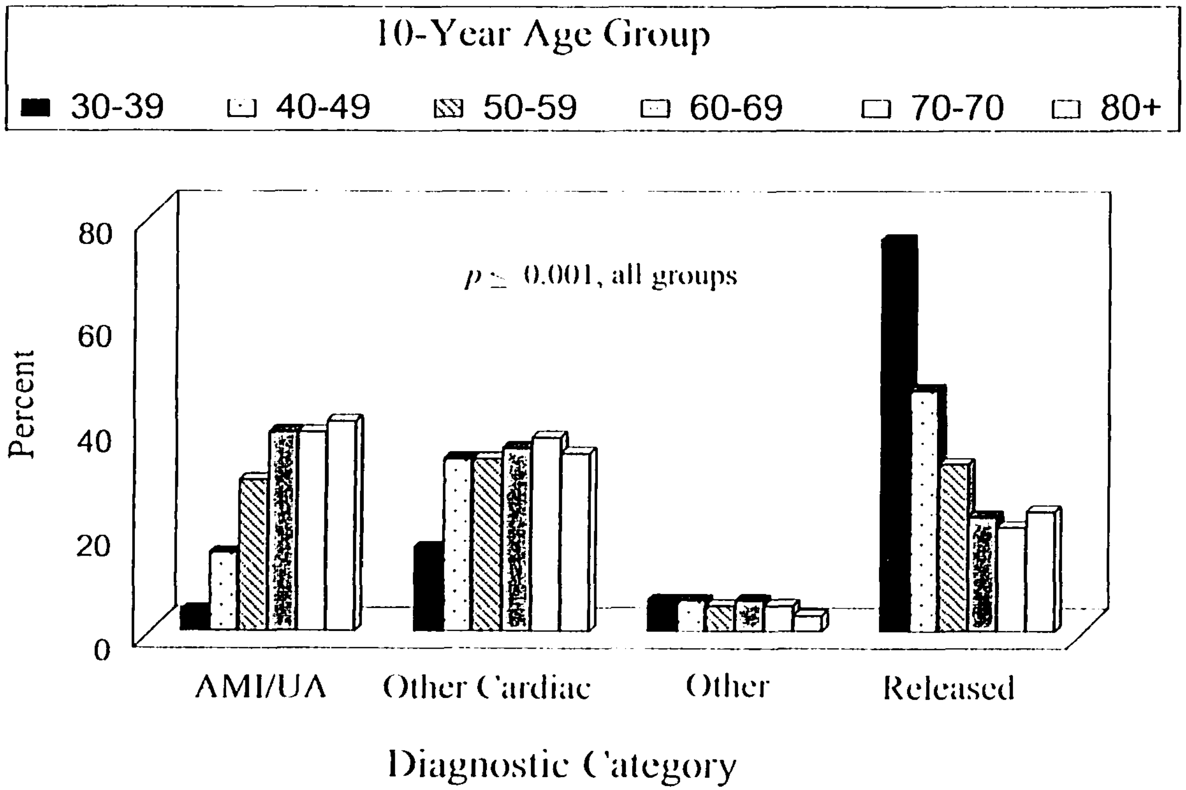

Figure 4. Diagnostic category by 10-year age group. AMI = acute myocardial infarction; UA = unstable angina.

Figures 5 through 8 show the three-way interactions between different diagnostic categories, sex, and age group. Cell sizes ranged from 5 to 255 members. In Figure 5 among the 40 to 69 year old patients, proportionately more of those diagnosed with AMI/UA were male, but a cross-over occurred between age groups 60 to 69 years and 70 to 79 years, after which proportionately more women were given this diagnosis. The difference in proportion of male and female patients with AMI/UA is particularly striking in the 80 years and over age group. In Figure 6 a somewhat similar pattern was found in the Other Cardiac diagnostic group although the age groups tended to cluster closer together compared with AMI/UA patients. In Figures 7 and 8 Released patients (Figure 8) showed a reversal of the age pattern seen among the Other (Figure 7) diagnostic groups but little evidence of a gender differential. Not unexpectedly, younger patients were sent home from the ED at proportionately higher rates than older people.

The relationship between diagnostic category and age group showed more variation among men than women. Although, in general, AMI/UA rates increased with age among males, the 80 years and older group had rates more comparable to those for the youngest age group. Among Other Cardiac patients, the rates for males ages 40 to 79 years were approximately the same, but again, the very oldest and youngest patients had much lower rates. The patterns found tended to be more consistent among females. Women showed a positive relationship between AMI/UA or Other Cardiac disease and age except for the oldest age group.

Separate chi-square analysis of ethnicity by age group and sex revealed that Blacks were overrepresented in the younger age groups and underrepresented in the older population (data not shown). Almost 70% of Blacks were less than 60 years of age, compared

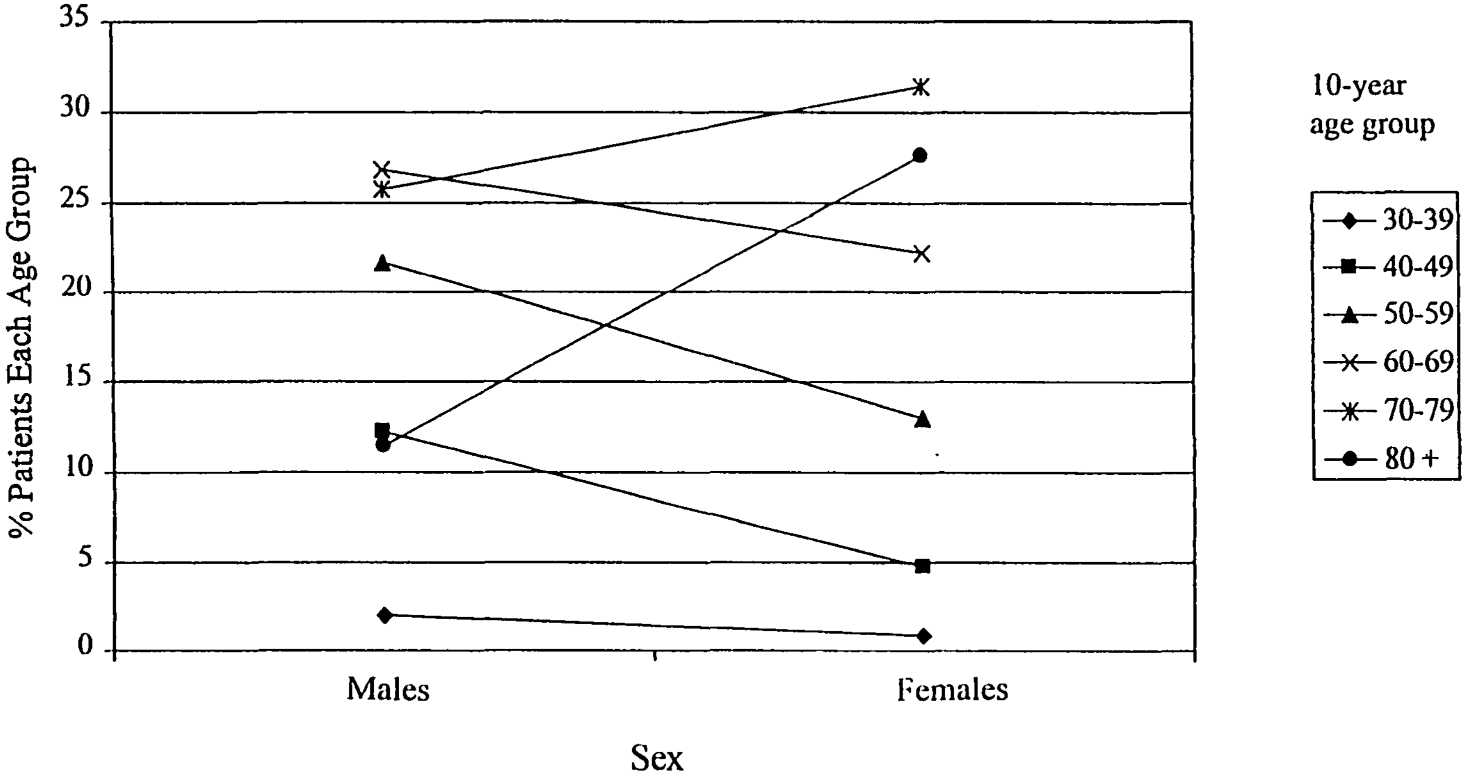

Figure 5. Three-way interactions among AMI/UA patients, sex, and 10-year age group. AMI = acute myocardial Infarction; UA = unstable angina.

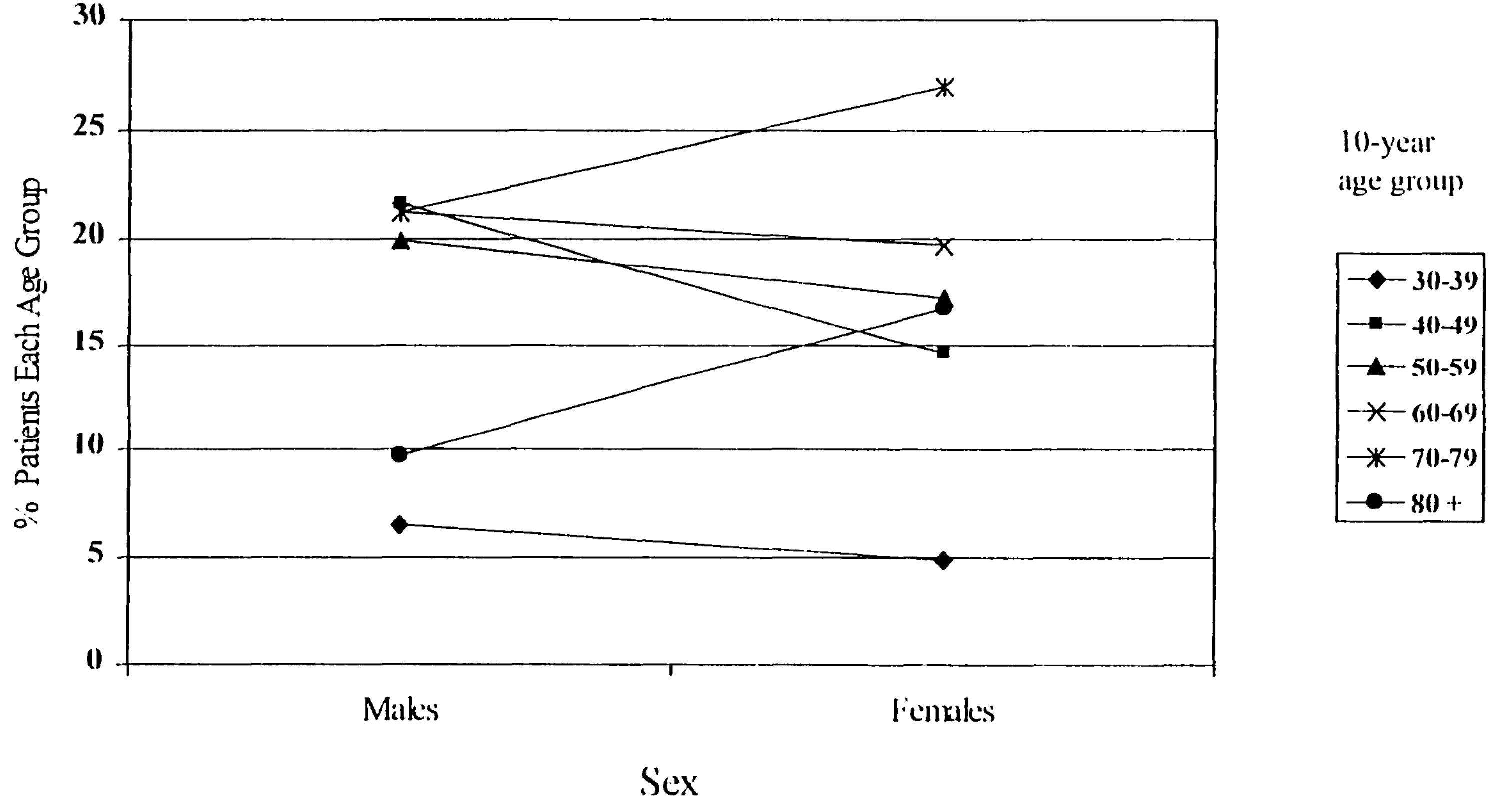

Figure 6. Three-way interactions among Other Cardiac patients, sex, and 10-year age group.

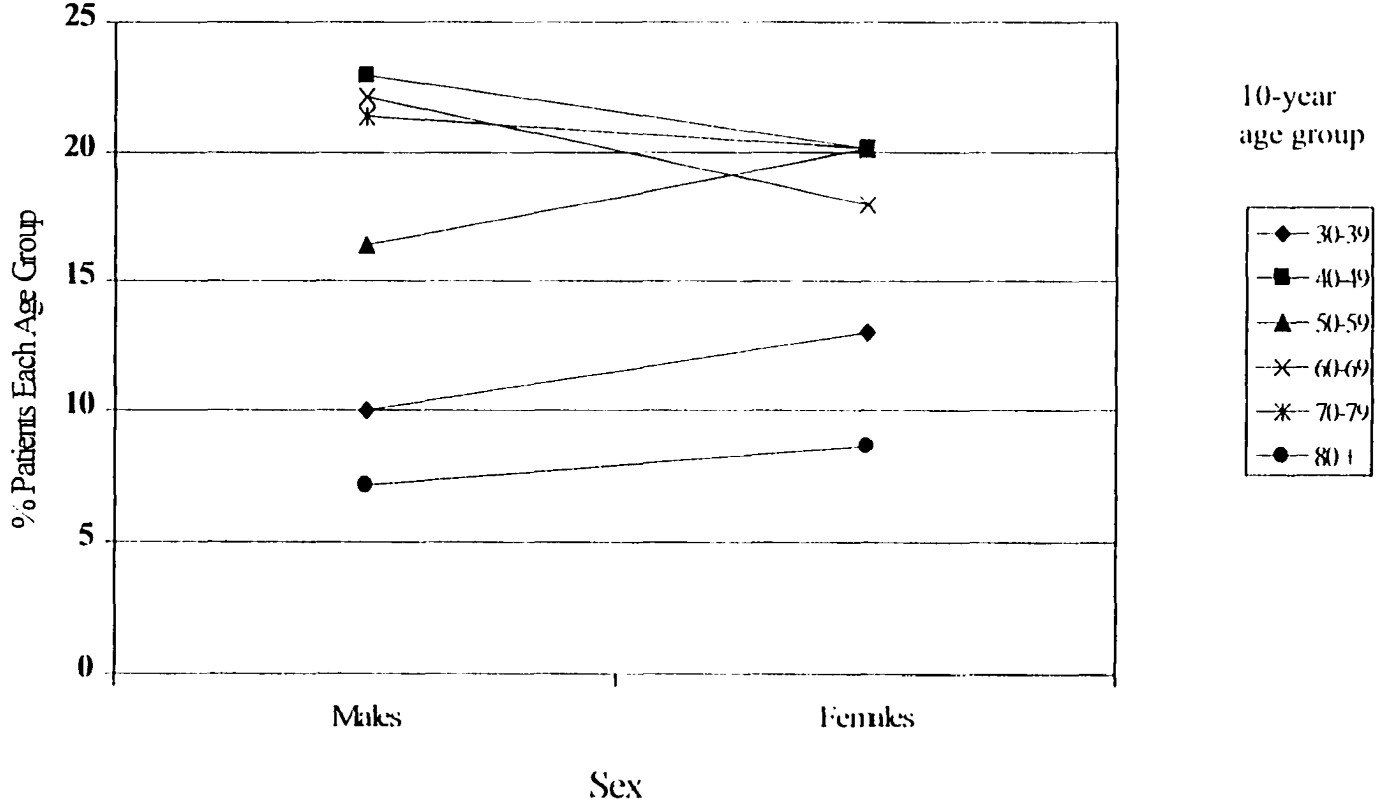

Figure 7. Three-way interactions among Other patients, sex, and 10-year age group.

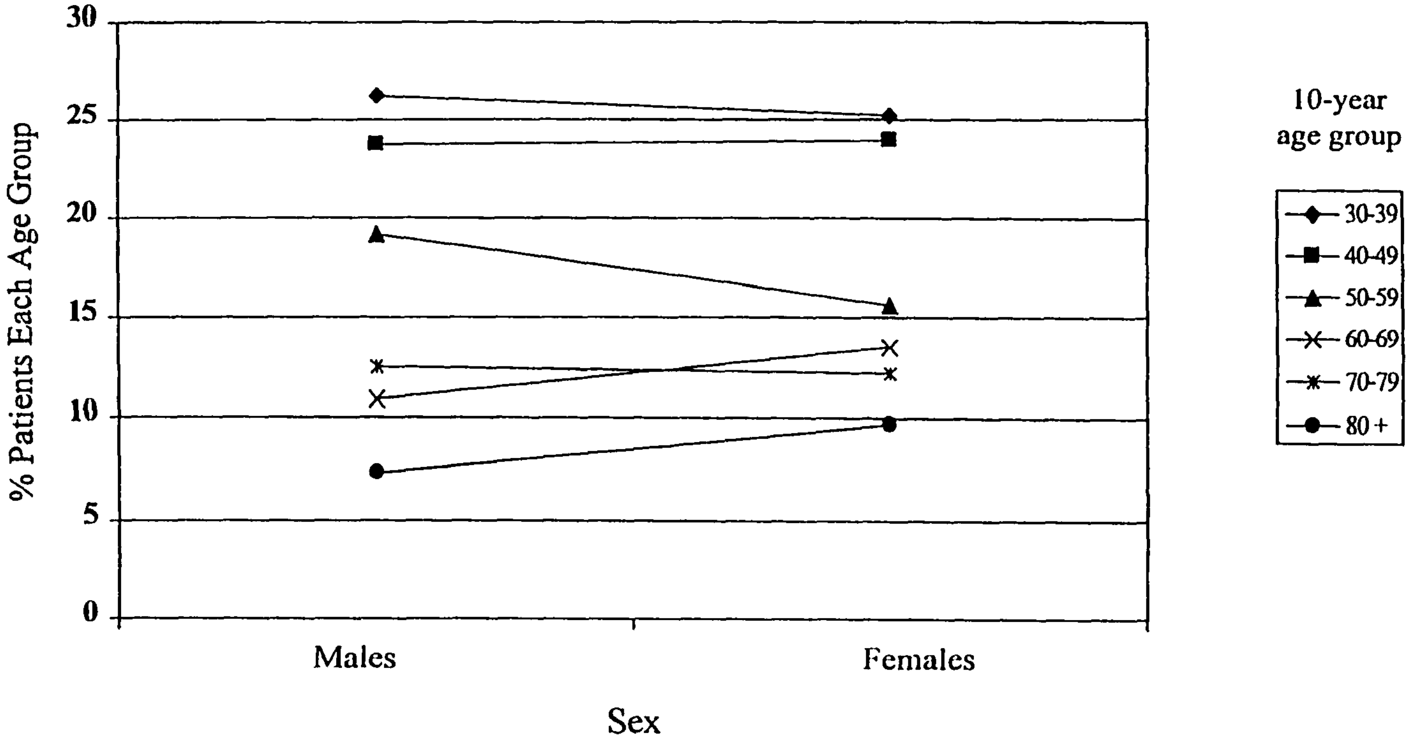

Figure 8. Three-way interactions among Released patients, sex, and 10-year age group.

with 43% of Whites and 51% of Hispanics ($p \le 0.001$). Ethnicity also differed significantly by sex ($p \le 0.001$). Fifty-four percent of Whites were male, compared to 40% of Blacks and 47% of Hispanics. The proportion of males and females was approximately equal in the youngest age group; thereafter, males had a proportionately greater representation until surpassed by women in the 80 years plus group.

Univariate analysis and log-linear analysis of the four diagnostic categories (AMI/UA, Other Cardiac, Other admitted, and Released) by demographic characteristics confirmed the hypothesis. Significant differences were found between diagnostic categories for sex, ethnicity, and age group, and a three-way interaction was seen among diagnostic category, sex, and age group (Figures 5A-5D).

Sociodemographic Differences in Symptom Presentation

Hypothesis 2 proposed that there would be significant differences between sex, ethnicity, and age group in symptoms among patients presenting with presumptive AMI/UA to EDs in study hospitals. It was further hypothesized that females, minorities, and older patients would be more likely to report atypical heart attack symptoms. Because of the large number of symptoms being analyzed (21 comparisons), a Bonferroni Correction was used to control for Type 1 error in all analyses of symptoms. Only results that remained statistically significant after applying the Bonferroni Correction (0.05/21, $p \le 0.002$) were reported.

The percentage of patients reporting each symptom is shown in Table 4. Other than chest pain, the symptom reported most often was dyspnea, followed by arm pain, nausea,

Table 4

Frequencies of Reported Symptoms

Symptom	% reporting	*n*
Abdominal pain	6.4	(343)
Arm pain	34.7	(1,861)
Back pain	14.1	(753)
Chest pain	85.9	(4,603)
Chest pressure	16.6	(892)
Chest tightness	9.5	(510)
Chest discomfort	20.1	(1,077)
Cough	11.6	(624)
Dizziness	9.9	(528)
Headache	4.7	(253)
Indigestion	2.5	(134)
Jaw pain	5.8	(312)
Unconsciousness	1.6	(84)
Vomiting	7.9	(421)
Nausea	27.4	(1,467)
Neck pain	10.6	(567)
Arm numbness	7.1	(382)
Palpitations	6.6	(351)
Dyspnea	45.7	(2,446)
Diaphoresis	22.7	(1,214)
Weakness	9.0	(482)

diaphoresis, and chest discomfort. All other symptoms were reported by fewer than 20% of patients.

Figure 9 illustrates the sex differences in symptoms in this sample of patients presenting with chest symptoms. Females presented more often than males with back pain, headache, palpitations, and weakness, while men were more likely than women to report diaphoresis. Otherwise, males and females did not differ significantly for those symptoms most typical of AMI/UA.

Differences in symptom presentation were found by ethnicity, also, with Whites generally reporting those symptoms more typical of AMI/UA compared with Blacks and Hispanics (Figure 10). Whites had higher rates of chest pressure and discomfort, arm and jaw pain, nausea, and diaphoresis compared to Blacks and Hispanics. Blacks and Whites reported similar rates of chest tightness, indigestion, nausea, and dyspnea, which were higher than those for Hispanic patients. Reports of indigestion were rare in all groups but were particularly uncommon among Hispanics. Blacks and Hispanics complained more often of headaches and cough than Whites. Blacks and Hispanics had similar rates of chest pressure, chest discomfort, and jaw pain, which were lower than those found among Whites. For some symptoms, Blacks were more similar to Whites but had rates more like Hispanics for others. Blacks had the highest reported rates for cough, vomiting, and dyspnea, but the percentage with dyspnea was similar to that for Whites. Only vomiting and cough showed distinctly different rates among Blacks compared with the other two groups.

Significant differences in symptom presentation were found by age group (Figure 11). Overall, most symptoms decreased with age, although the youngest age group (30 to

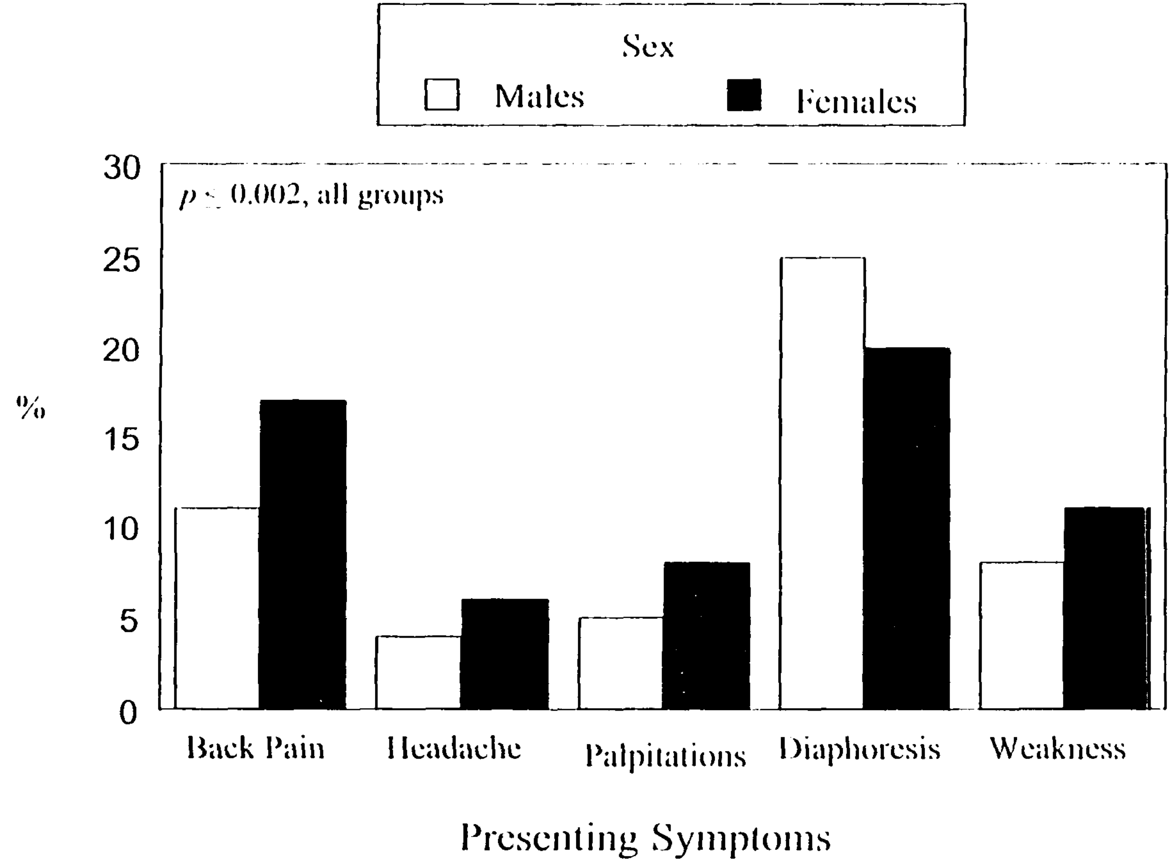

Figure 9. Presenting symptoms by sex.

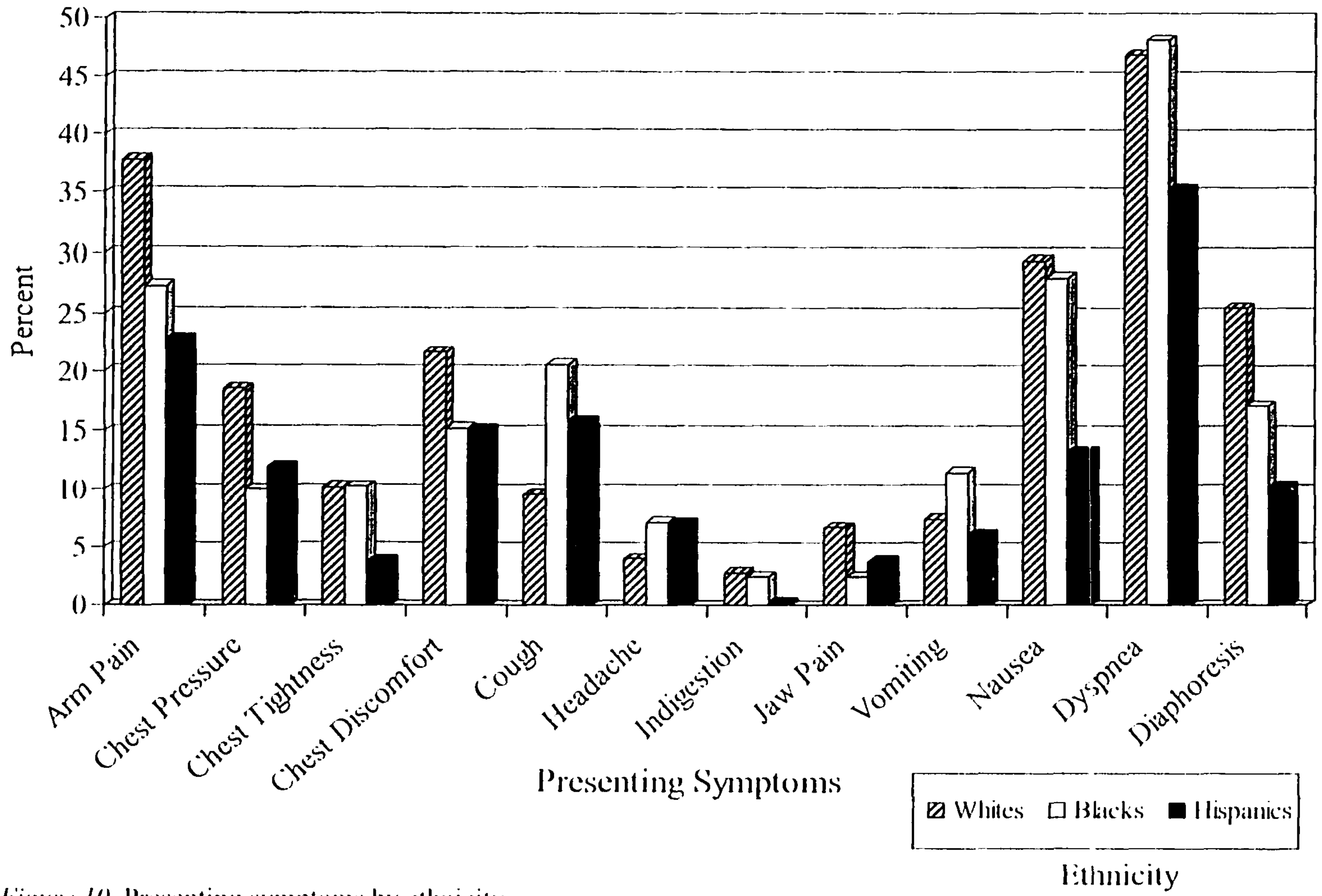

Figure 10. Presenting symptoms by ethnicity.

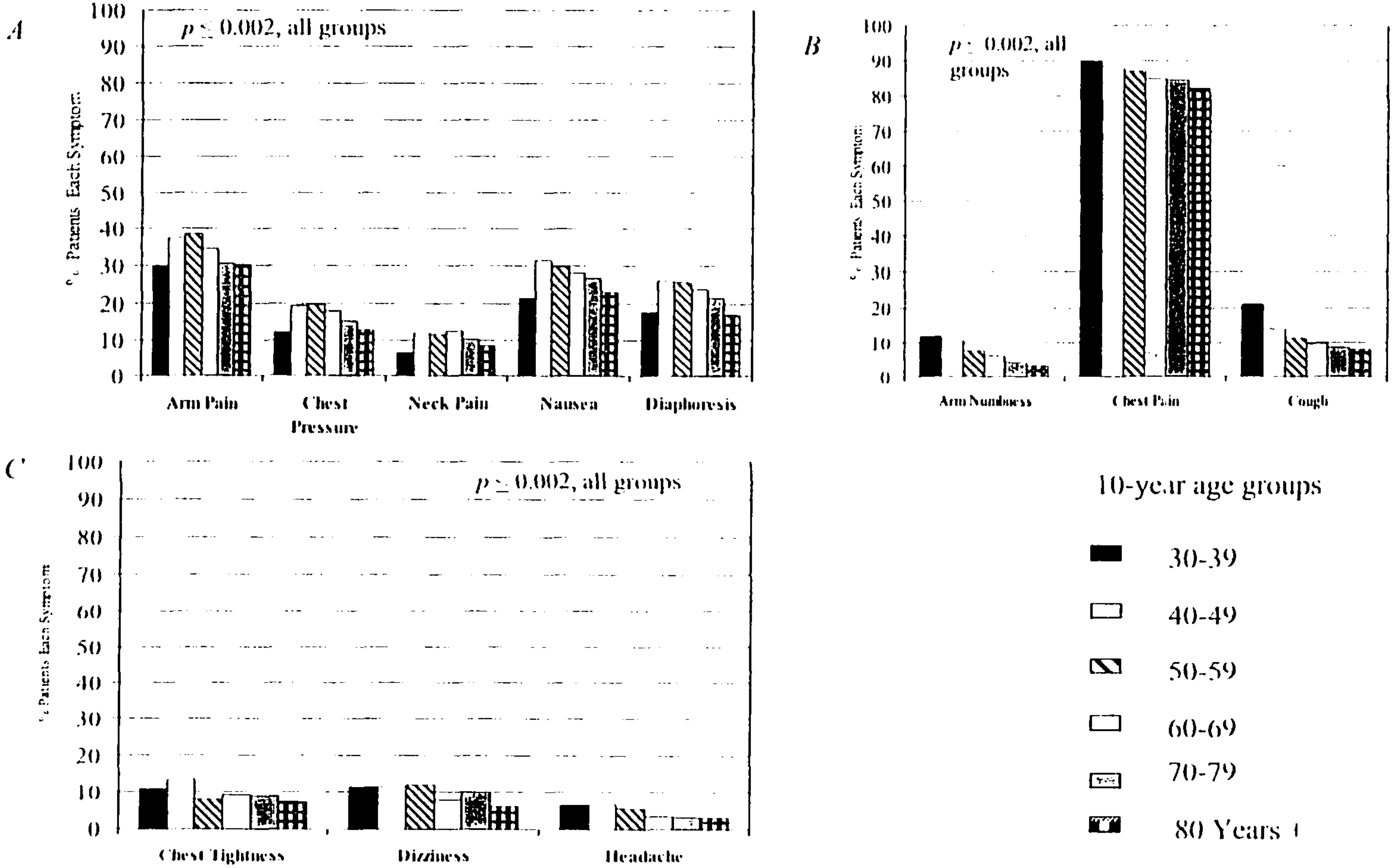

Figure 11. Presenting symptoms by 10-year age group. *A*. Symptoms that increase and decrease with age. *B*. Symptoms that decrease with age. *C*. Inconsistent symptoms.

39 years) often showed low rates for some symptoms. Three different patterns of symptoms were apparent. The first pattern showed that, as age increased, reports of chest pain, arm numbness, and cough decreased consistently (Figure 11A). The second pattern was curvilinear in shape, with lower rates among the youngest and oldest age groups and higher rates among the middle age groups for chest pain, neck pain, nausea, and diaphoresis (Figure 11B) There was an inconsistent pattern for chest tightness, headache, and dizziness with no discernable predictable relationships (Figure 11C).

In separate analyses by sex, significant ethnic differences were found for chest pressure and chest tightness among females, but not males (Table 5). In the sample overall, White women reported higher rates of chest pressure compared with Black and Hispanic women, and Hispanic women were least likely to report chest tightness. White males reported higher rates of chest discomfort and jaw pain than Black or Hispanic males, but these symptoms did not differ by ethnicity among women.

AMI/UA. Some differences remained statistically significant after analysis by diagnostic group. Among AMI/UA patients (Table 6), only males differed significantly by ethnicity for arm pain, with White males being more likely to report this symptom. Black males were significantly more likely to present with cough compared with White or Hispanic males, but cough did not differ by ethnicity among females. Females diagnosed with AMI/UA did differ significantly by ethnicity for nausea, with White females reporting the highest rates and Hispanic females reporting the lowest rates.

Table 5

Presenting Symptoms by Ethnicity and Sex

	White		Black		Hispanic		
Presenting symptom	%	(*n*)	%	(*n*)	%	(*n*)	*p*-value
Arm pain							
Males	36	(800)	26	(69)	21	(59)	0.001*
Females	40	(738)	28	(116)	25	(79)	0.001*
Chest pressure							
Males	17	(384)	12	(33)	12	(34)	0.010
Females	20	(367)	9	(35)	12	(39)	0.001*
Chest tightness							
Males	10	(220)	10	(28)	4	(11)	0.003
Females	11	(197)	10	(42)	4	(12)	0.001*
Chest discomfort							
Males	21	(472)	13	(34)	14	(39)	0.001*
Females	22	(410)	17	(69)	16	(53)	0.011
Cough							
Males	10	(210)	20	(54)	12	(33)	0.001*
Females	10	(181)	20	(83)	20	(63)	0.001*
Jaw pain							
Males	8	(156)	2	(10)	3	(11)	0.001*
Females	2	(41)	2	(5)	1	(3)	0.617
Nausea							
Males	27	(598)	27	(69)	15	(43)	0.001*
Females	32	(598)	30	(121)	12	(38)	0.001*
Dyspnea							
Males	47	(1,026)	47	(126)	34	(96)	0.001*

Table 5 (Continued)

Presenting symptom	White %	White (n)	Black %	Black (n)	Hispanic %	Hispanic (n)	p-value
Females	47	(879)	49	(200)	37	(119)	0.001*
Diaphoresis							
Males	27	(603)	19	(51)	10	(29)	0.001*
Females	23	(433)	16	(65)	10	(33)	0.001*

*Differences within row are significant at $p \leq 0.001$.

Other cardiac. Among patients diagnosed with Other Cardiac disease, there were no significant differences by ethnicity for any symptoms among males. Among females, Black women were less likely to report chest pressure compared to White and Hispanic women. White females reported significantly lower rates for cough compared to Black and Hispanic females. As in the AMI UA group, Hispanic females were significantly less likely than White or Black females to report nausea. There were no significant differences by ethnicity among males or females in the Other diagnostic group.

Released. Males in the Released group differed by ethnicity only for diaphoresis, with Hispanic males reporting rates about one fourth those of White males. Rates for Black males were intermediate. The same pattern was found among females. Hispanic women were also significantly less likely to present with chest tightness or nausea compared to White or Black women.

Table 6

Presenting Symptoms by Ethnicity and Sex for Each Diagnostic Group

Diagnostic group	White		Black		Hispanic		
Presenting symptom	%	(*n*)	%	(*n*)	%	(*n*)	*p*-value
AMI/UA							
Arm pain							
Males	47	(389)	31	(36)	28	(23)	0.002*
Females	47	(230)	34	(13)	31	(18)	0.020
Cough							
Males	4	(31)	19	(7)	7	(6)	0.000*[a]
Females	6	(28)	9	(3.)	16	(9)	0.022[a]
Nausea							
Males	31	(256)	44	(16)	25	(20)	0.102
Females	39	(188)	29	(11)	16	(98)	0.001*
Other cardiac							
Chest pressure							
Males	19	(133)	14	(12)	15	(10)	0.388
Females	23	(162)	9	(11)	15	(9)	0.000*
Cough							
Males	10	(69)	13	(11)	8	(5)	0.590
Females	6	(42)	16	(20)	16	(10)	0.000*
Nausea							
Males	28	(196)	33	(29)	19	(12)	0.124
Females	34	(236)	41	(53)	15	(9)	0.002*

Table 6 (Continued)

Diagnostic group	White		Black		Hispanic		
Presenting symptom	%	(*n*)	%	(*n*)	%	(*n*)	*p*-value
Released							
Chest tightness							
Males	9	(54)	8	(9)	3	(4)	0.057
Females	11	(64)	11	(23)	2	(4)	0.001*
Nausea							
Males	20	(112)	15	(18)	7	(10)	0.005
Females	23	(137)	22	(48)	9	(17)	0.000*
Diaphoresis							
Males	16	(89)	11	(13)	4	(5)	0.001*
Females	14	(83)	8	(18)	3	(6)	0.000*

[a] High percentage of cells (30% +) have fewer than five members.
*Differences within row are significant at $p \leq 0.001$.

Log-linear analysis was used to examine higher level interactions between symptoms and demographic variables. The saturated model revealed no three-way or four-way interactions between individual symptoms and sex, ethnicity, or age group.

Hypothesis 2 was supported by the results. Significant differences were found in presenting symptoms by all of the demographic characteristics examined. At presentation females reported some atypical AMI/UA symptoms more often than men, but the sexes did not differ for typical heart attack symptoms except that males reported more diaphoresis than women. There were ethnic differences in symptom presentation with Whites reporting the typical symptoms of AMI more frequently than Blacks or Hispanics. Age groups showed the most variation in symptom presentation. Overall, the percentage of patients reporting typical AMI symptoms decreased with age. Further analyses revealed differences in symptom presentation by ethnicity and sex. In addition, there were significant differences in symptom presentation by ethnicity and sex within each diagnostic category.

Differences in Symptom Presentation Between Diagnostic Groups

Hypothesis 3 tested the relationships between symptom presentation and diagnostic group. Adjusted odds ratios (AOR), 95% CIs, and probability values were calculated for presenting symptoms by diagnostic group, controlling for community, sex, age group, and ethnicity. Again, the Bonferroni Correction was used to control for Type I error. Two sets of logistic regression analyses were performed. Set 1 compared released with admitted patients, then, in Set 2, further analyses were performed comparing AMI/UA patients with all others and, similarly, comparing Other Cardiac patients with all other patients in an attempt to distinguish clinically important differences in symptom presentation between these groups. The Set 2 analysis compared pairs of diagnostic groups, each of the four groups was compared to all other groups. Finally, some symptoms were combined into physiologically similar groupings to determine if these combined symptoms would better predict diagnostic category. These patients were selected based on a presentation of chest pain or other chest symptoms and, thus, may not be representative of all AMI/UA patients.

Logistic regression analysis, Set 1. The first set of analyses were performed in an attempt to define symptom differences that might be helpful to clinicians for making assessments in the ED. Separate logistic regression models within this set compared (a) symptoms reported by admitted patients with those of patients released to home from the ED, (b) patients admitted and diagnosed with AMI/UA versus all other patients, and (c) patients admitted and diagnosed with some Other Cardiac diagnosis (non-AMI/UA) versus all other patients. All analyses controlled for community, sex, ethnicity, and age group. Adjusted odds ratios and 95% confidence intervals from the regression models are presented in Figures 12 through 14.

Results from analysis of admitted versus released patients (referent group) are shown in Figure 12. Admitted patients were only half as likely to report abdominal pain (AOR 0.5, 95% CI 0.4-0.7) and cough (AOR 0.5, 95% CI 0.4-0.6) as released patients. Admitted patients were approximately twice as likely as released patients to report chest pressure (AOR 2.0, 95% CI 1.6-2.4), arm (AOR 1.9, 95% CI 1.7-2.2) and jaw pain (AOR 2.0, 95% CI 1.5-2.7), nausea (AOR 2.1, 95% CI 1.8-2.5), or dyspnea (AOR 1.9, 95% CI 1.7-2.2) and were three times more likely to have diaphoresis (AOR 3.0, 95% CI 2.6-3.7). As would be expected, patients were more likely to be admitted if they had suffered an episode of unconsciousness (AOR 3.1, 95% CI 1.6-6.1). Perhaps because screening criteria limited eligibility to patients presenting with some indication of chest sensation (usually chest pain), no differences were found between patients admitted and those released from the ED for chest pain, tightness, or discomfort.

The second logistic regression analysis in this set compared presenting symptoms reported by AMI/UA patients with those of all other patients in the sample (referent group). The results were similar to those found between admitted and released patients (Figure 13). Compared with all other patients, AMI/UA patients had more arm pain

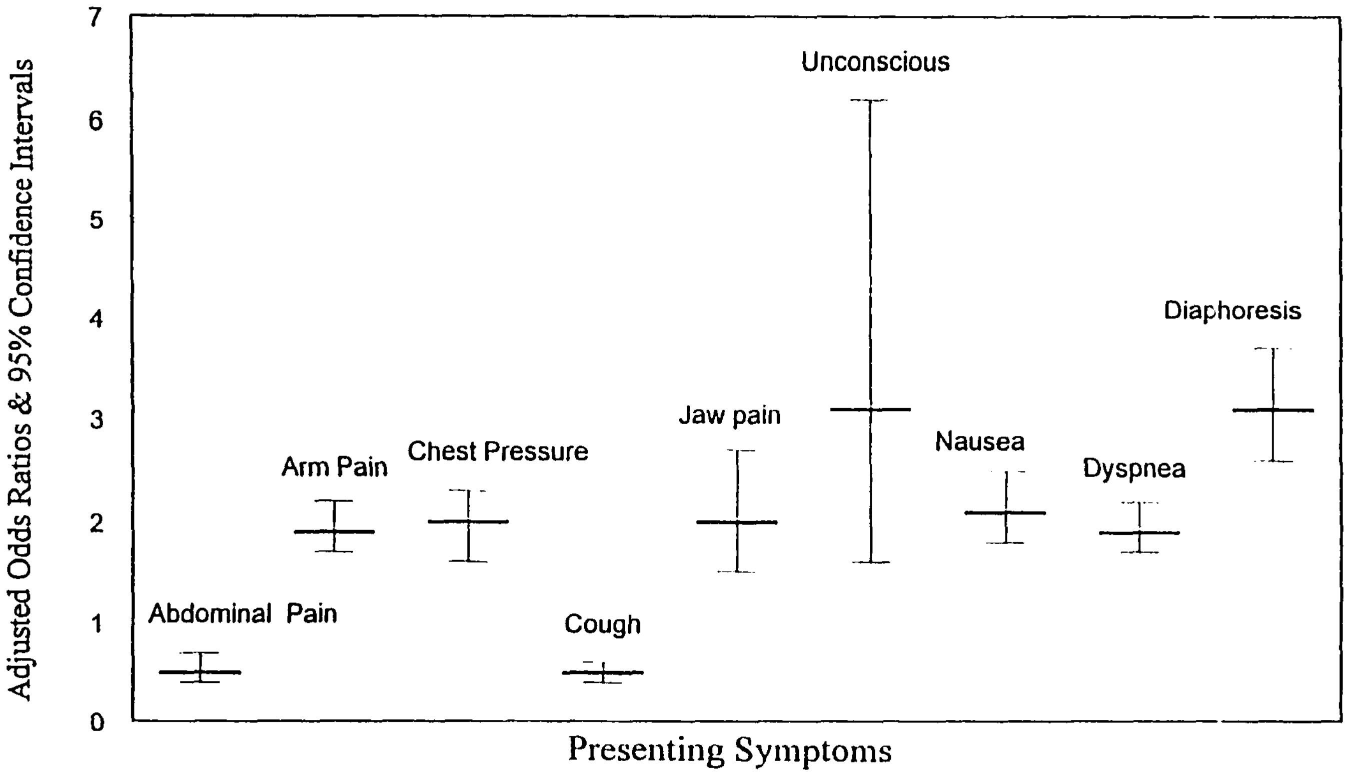

Figure 12. Logistic regression analysis of presenting symptoms by admitted versus released patients ($p < 0.002$).

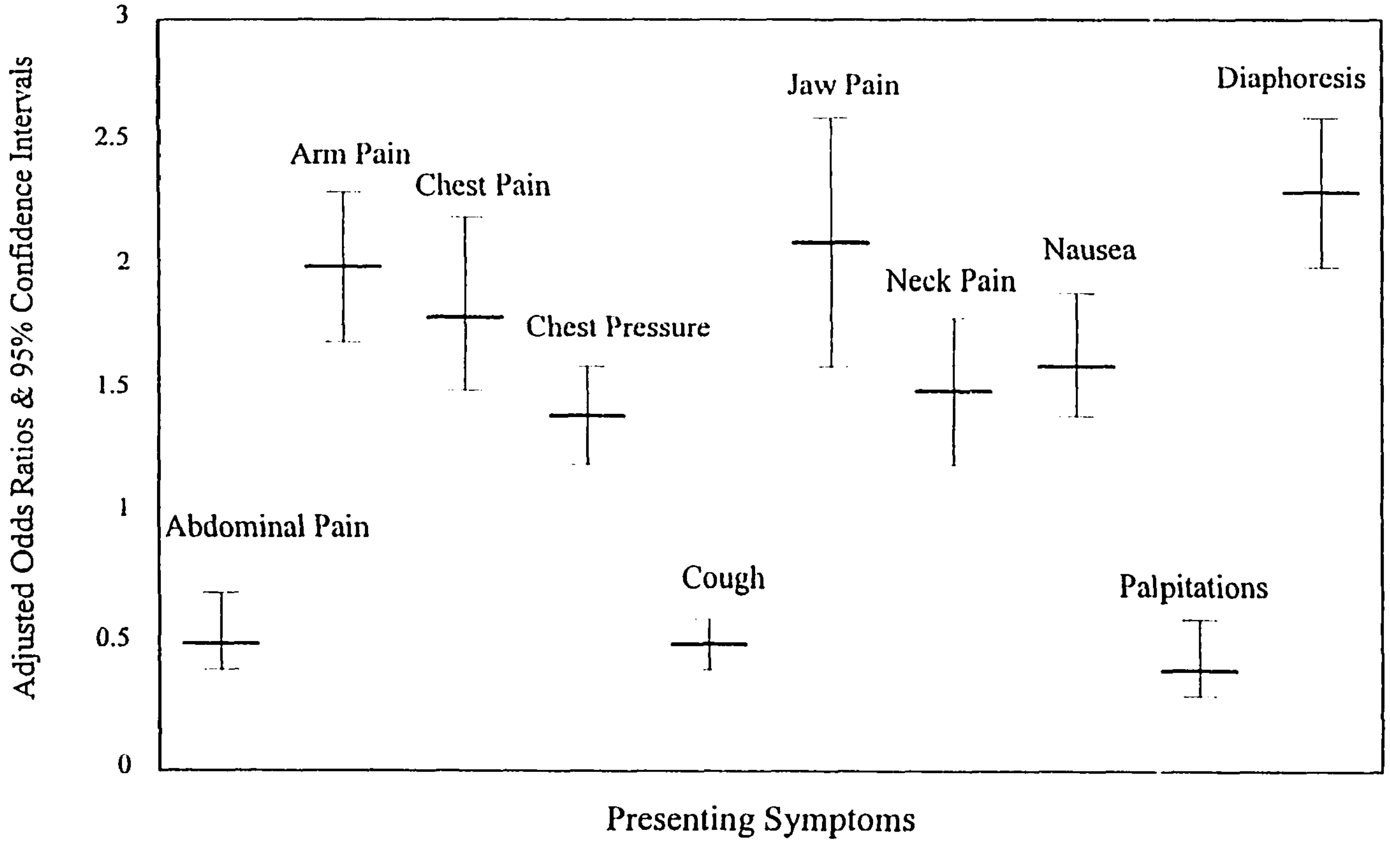

Figure 13. Logistic regression analysis of presenting symptoms by acute myocardial infarction or unstable angina versus all other patients ($p < 0.002$).

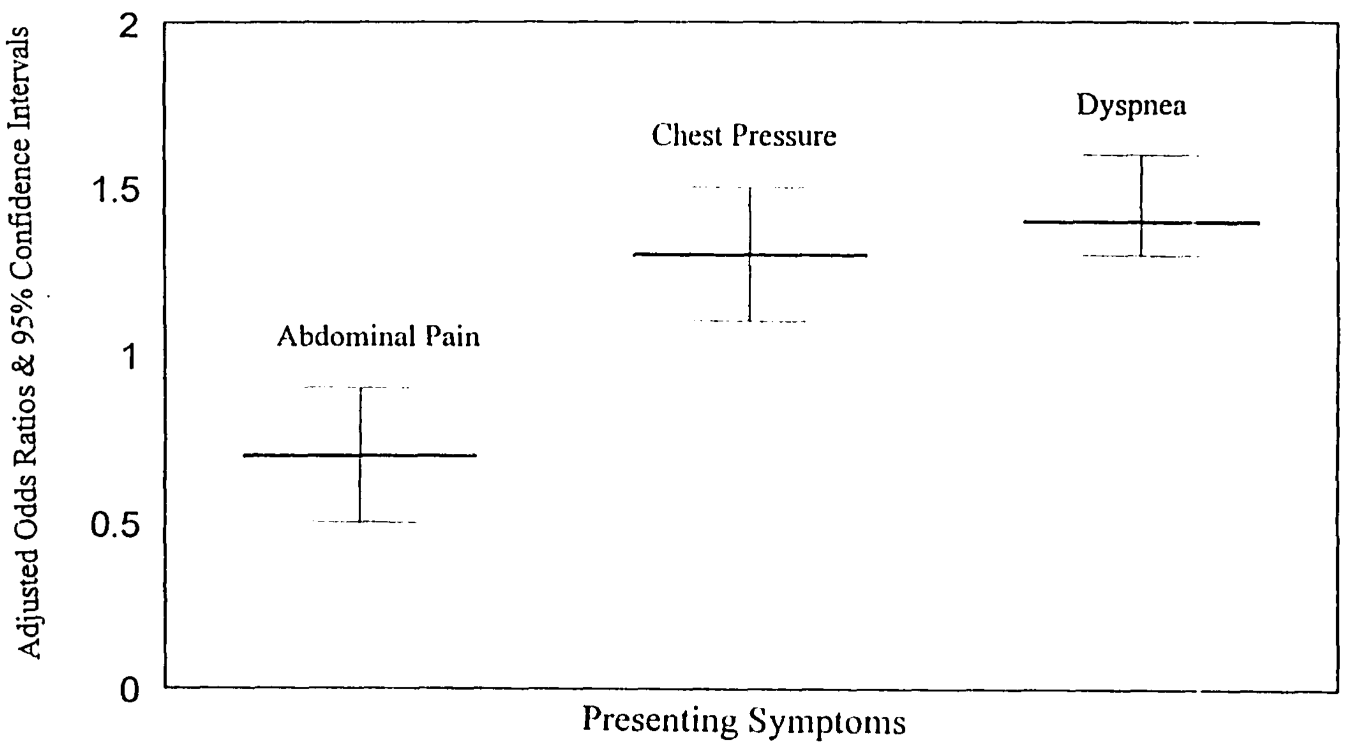

Figure 14. Logistic regression analysis of presenting symptoms by other cardiac versus all other patients ($p < 0.002$).

(AOR 2.0, 95% CI 1.7-2.3), chest pain (AOR 1.8, 95% CI 1.5-2.2), chest pressure (AOR 1.4, 95% CI 1.2-1.6), jaw (AOR 2.0, 95% CI 1.6-2.6) and neck pain (AOR 1.5, 95% CI 1.2-1.8), nausea (AOR 1.6, 95% CI 1.4-1.9), and diaphoresis (AOR 2.3, 95% CI 2.0-2.6). They were about half as likely as other patients to report abdominal pain (AOR 0.5, 95% CI 0.4-0.7), cough (AOR 0.5, 95% CI 0.4-0.6), or palpitations (AOR 0.4, 95% CI 0.3-0.6).

There were fewer differences between patients diagnosed with a cardiac disease other than AMI/UA and all other patients (Figure 14). Other Cardiac patients had more chest pressure (AOR 1.3, 95% CI 1.1-1.5) and dyspnea (AOR 1.4, 95% CI 1.3-1.6) but less abdominal pain (AOR 0.7, 95% CI 0.5-0.9) compared with all other patients.

Logistic regression analysis, Set 2. The second series of logistic regression analyses compared each diagnostic category with each of the others to determine more specific symptom presentation differences, while controlling for demographic factors (Table 7). Significant differences by presenting symptoms were revealed between each of the diagnostic group pairs. Compared with patients released to home from the ED, the AMI/UA group reported more chest pain (AOR 1.7, 95% CI 1.3-2.1) or pressure (AOR 2.2, 95% CI 1.7-2.7); arm (AOR 2.5, 95% CI 2.1-3.0), jaw (AOR 2.4, 95% CI 1.7-3.5), or neck (AOR 1.6, 95% CI 1.2-2.0) pain; nausea (AOR 2.3, 95% CI 1.9-2.7); dyspnea (AOR 1.8, 95% CI 1.5-2.2); and diaphoresis (AOR 4.1, 95% CI 3.3-5.1) than Released patients. AMI/UA patients were much less likely to present with abdominal pain (AOR 0.4, 95% CI 0.3-0.6), cough (AOR 0.4, 95% CI 0.3-0.5), or palpitations (AOR 0.4, 95% CI 0.2-0.5) compared to released patients.

Table 7

Logistic Regression Analysis of Diagnostic Category Controlling for Community, Age, Sex, and Ethinicity

	AMI/UA vs. released			Other cardiac vs. released			Other vs. released		
Presenting symptom	AOR	(CI)	*p*-value	AOR	(CI)	*p*-value	AOR	(CI)	*p*-value
Abdominal pain	0.41	(0.29, 0.58)	0.000	0.50	(0.37, 0.68)	0.000	1.68	(1.13, 2.49)	0.011
Arm pain	2.51	(2.10, 3.00)	0.000	1.72	(1.46, 2.01)	0.000	1.01	(0.75, 1.36)	0.955
Arm numbness	0.90	(0.64, 1.25)	0.526	1.24	(0.94, 1.63)	0.122	1.05	(0.64, 1.73)	0.857
Back pain	1.00	(0.79, 1.27)	0.968	1.11	(0.90, 1.37)	0.322	1.39	(0.97, 2.00)	0.072
Chest pain	1.67	(1.31, 2.13)	0.000	1.00	(0.81, 1.23)	0.996	1.57	(0.41, 0.78)	0.001
Chest pressure	2.15	(1.70, 2.71)	0.000	1.92	(1.56, 2.37)	0.000	1.58	(1.09, 2.28)	0.016
Chest tightness	0.99	(0.74, 1.34)	0.960	1.34	(1.04, 1.71)	0.021	1.09	(0.70, 1.71)	0.706
Chest discomfort	0.88	(0.72, 1.08)	0.216	0.94	(0.79, 1.13)	0.536	0.86	(0.61, 1.22)	0.397
Cough	0.36	(0.27, 0.48)	0.000	0.50	(0.40, 0.63)	0.000	0.76	(0.52, 1.12)	0.161
Dizziness	1.03	(0.77, 1.37)	0.852	1.35	(1.06, 1.73)	0.015	1.71	(1.14, 2.58)	0.010
Headache	0.53	(0.35, 0.80)	0.003	0.86	(0.62, 1.18)	0.340	0.65	(0.35, 1.23)	0.184
Indigestion	0.94	(0.56, 1.59)	0.825	1.04	(0.65, 1.67)	0.869	1.58	(0.75, 3.33)	0.234

Table 7 (Continued)

	AMI/UA vs. released			Other cardiac vs. released			Other vs. released		
Presenting symptom	AOR	(CI)	*p*-value	AOR	(CI)	*p*-value	AOR	(CI)	*p*-value
Jaw pain	2.43	(1.70, 3.46)	0.000	1.75	(1.24, 2.48)	0.002	1.14	(0.59, 2.22)	0.696
Neck pain	1.55	(1.20, 2.01)	0.001	1.23	(0.88, 1.44)	0.341	1.04	(0.66, 1.63)	0.871
Unconcious	2.64	(1.15, 6.05)	0.022	3.24	(1.59, 6.60)	0.001	4.60	(1.70, 12.47)	0.003
Vomiting	1.35	(1.00, 1.83)	0.049	1.03	(1.77, 0.36)	0.864	2.37	(1.59, 3.52)	0.000
Nausea	2.25	(1.86, 2.73)	0.000	1.97	(1.65, 2.34)	0.000	1.84	(1.37, 2.48)	0.000
Palpitations	0.35	(0.24, 0.51)	0.000	0.92	(0.70, 1.20)	0.536	0.74	(0.44, 1.25)	0.263
Dyspnea	1.82	(1.54, 2.15)	0.000	1.99	(1.72, 2.32)	0.000	1.98	(1.51, 2.59)	0.000
Diaphoresis	4.07	(3.27, 5.06)	0.000	2.67	(2.18, 3.26)	0.000	1.71	(1.21, 2.43)	0.003
Weakness	1.12	(0.83, 1.53)	0.462	1.53	(1.18, 1.97)	0.001	1.87	(1.23, 2.83)	0.003

Note. AOR = adjusted odds ratios; CI = confidence intervals; AMI = acute myocardial infarction; UA = unstable angina.

Patients admitted and diagnosed with Other Cardiac conditions reported more occurrences of arm pain (AOR 1.7, 95% CI 1.5-2.0), chest pressure (AOR 1.9, 95% CI 1.6-2.4), jaw pain (AOR 1.8, 95% CI 1.2-2.5), unconsciousness (AOR 3.2, 95% CI 1.6-6.6), nausea (AOR 2.0, 95% CI 1.7-2.3), dyspnea (AOR 2.0, 95% CI 1.7-2.3), diaphoresis (AOR 2.7, 95% CI 2.2-3.3), and weakness (AOR 1.5, 95% CI 1.2-2.0) than Released patients (Table 7). Other Cardiac patients differed from Released patients in that they were less likely to report abdominal pain (AOR 0.5, 95% CI 0.4-0.7) and cough (AOR 0.5, 95% CI 0.4-0.6).

Some differences were found also between patients admitted and subsequently given an Other diagnosis (noncardiac) compared to Released patients (Table 7). Patients with an Other diagnosis were more likely than Released patients to present with vomiting (AOR 2.4, 95% CI 1.6-3.5), nausea (AOR 1.8, 95% CI 1.4-2.5), and dyspnea (AOR 2.0, 95% CI 1.5-2.6). They were less likely than Released patients to report chest pain (AOR 0.6, 95% CI 0.4-0.8), but the two groups did not differ significantly for any other chest symptoms.

There were also significant differences in symptom presentation by diagnostic group among admitted patients (Table 8). Patients admitted and diagnosed with AMI/UA differed from those admitted and diagnosed with Other Cardiac disease in that AMI/UA patients had significantly more chest (AOR 1.7, 95% CI 1.3-2.1), arm (AOR 1.6, 95% CI 1.4-1.9), jaw (AOR 1.8, 95% CI 1.3-2.3), and neck (AOR 1.5, 95% CI 1.2-1.9) pain; vomiting (AOR 1.6, 95% CI 1.2-2.1); nausea (AOR 1.3, 95% CI 1.2-1.6); and diaphoresis (AOR 1.6, 95% CI 1.4-1.9). AMI/UA patients were less likely than Other Cardiac patients to report cough (AOR 0.6, 95% CI 0.4-0.8) or palpitations (AOR 0.4, 95% CI

Table 8

Logistic Regression Analysis of Diagnostic Category Versus Referent Group Controlling for Community, Age, Sex, and Ethinicity

	AMI/UA vs. other cardiac			AMI/UA vs. other			Other cardiac vs. other		
Presenting symptom	AOR	(CI)	*p*-value	AOR	(CI)	*p*-value	AOR	(CI)	*p*-value
Abdominal pain	0.78	(0.55, 1.10)	0.157	0.23	(0.14, 0.37)	0.000	0.30	(0.20, 0.45)	0.000
Arm pain	1.62	(1.39, 1.88)	0.000	2.37	(1.74, 3.24)	0.000	1.70	(1.27, 2.27)	0.000
Arm numbness	0.77	(0.57, 1.04)	0.092	0.88	(0.50, 1.55)	0.660	1.18	(0.72, 1.94)	0.501
Back pain	0.93	(0.76, 1.15)	0.520	0.73	(0.50, 1.07)	0.108	0.83	(0.58, 1.18)	0.289
Chest pain	1.65	(1.32, 2.05)	0.000	2.96	(2.05, 4.26)	0.000	1.83	(1.33, 2.52)	0.000
Chest pressure	1.07	(0.89, 1.28)	0.497	1.23	(0.85, 1.78)	0.274	1.15	(0.81, 1.62)	0.429
Chest tightness	0.77	(0.61, 1.00)	0.042	1.03	(0.64, 1.67)	0.898	1.33	(0.86, 2.06)	0.199
Chest discomfort	0.99	(0.83, 1.20)	0.950	1.06	(0.73, 1.54)	0.754	1.11	(0.79, 1.57)	0.541
Cough	0.59	(0.44, 0.79)	0.000	0.51	(0.32, 0.81)	0.004	0.69	(0.46, 1.02)	0.060
Dizziness	0.89	(0.70, 1.14)	0.363	0.68	(0.44, 1.04)	0.076	0.87	(0.59, 1.28)	0.474
Headache	0.68	(0.45, 1.03)	0.066	0.65	(0.32, 1.33)	0.238	1.24	(0.66, 2.33)	0.511
Indigestion	0.95	(0.60, 1.50)	0.829	0.79	(0.36, 1.75)	0.568	0.74	(0.37, 1.52)	0.415

Table 8 (Continued)

Presenting symptom	AMI/UA vs. other cardiac AOR	(CI)	*p*-value	AMI/UA vs. other AOR	(CI)	*p*-value	Other cardiac vs. other AOR	(CI)	*p*-value
Jaw pain	1.76	(1.33, 2.34)	0.000	2.14	(1.12, 4.27)	0.021	1.35	(0.71, 2.53)	0.349
Neck pain	1.48	(1.18, 1.85)	0.001	1.44	(0.92, 2.27)	0.014	1.17	(0.76, 1.81)	0.476
Unconcious	0.62	(0.36, 1.07)	0.087	0.77	(0.30, 1.98)	0.588	0.93	(0.42, 2.06)	0.866
Vomiting	1.57	(1.19, 2.07)	0.002	0.59	(0.39, 0.89)	0.012	0.45	(0.31, 0.66)	0.000
Nausea	1.34	(1.15, 1.58)	0.000	1.35	(1.99, 1.83)	0.057	1.07	(0.80, 1.42)	0.658
Palpitations	0.42	(0.30, 0.61)	0.000	0.63	(0.33, 1.20)	0.158	1.25	(0.75, 2.09)	0.390
Dyspnea	0.92	(0.80, 1.07)	0.278	0.90	(0.68, 1.18)	0.436	0.96	(0.74, 1.25)	0.773
Diaphoresis	1.64	(1.39, 1.93)	0.000	2.26	(1.60, 3.18)	0.000	1.50	(1.08, 2.07)	0.015
Weakness	0.72	(0.56, 0.93)	0.014	0.61	(0.39, 0.96)	0.032	0.78	(0.53, 1.15)	0.215

Note. AMI = acute myocardial infarction; UA = unstable angina; AOR = adjusted odds ratios; CI = confidence interval.

0.3-0.6). AMI/UA patients differed from patients in the Other diagnostic group in that AMI/UA patients reported more chest pain (AOR 3.0, 95% CI 2.1-4.3), arm pain (AOR 2.4, 95% CI 1.7-3.2), and diaphoresis (AOR 2.3, 95% CI 1.6-3.2) but lower rates of abdominal pain (AOR 0.2, 95% CI 0.1-0.4). The logistic regression analysis showed that patients with non-AMI/UA cardiac disease reported significantly more chest (AOR 1.9, 95% CI 1.3-2.5) and arm pain (AOR 1.7, 95% CI 1.3-2.3) but less abdominal pain (AOR 0.3, 95% CI 0.2-0.5) or vomiting (AOR 0.5, 95% CI 0.3-0.7) compared to patients with Other diagnosis (Table 8).

Log-linear analysis was not performed on the logistic regression results. With 21 symptoms and 4 diagnostic categories, it would not have been possible to interpret the complex interactions that would likely result; hence, these analyses were dropped from further consideration.

Differences in Combined Symptom Presentation Between Diagnostic Groups

Following regression analysis of individual symptoms, the symptoms were grouped as indicated earlier (chest symptoms, radiation symptoms, nausea and vomiting, dizziness and unconsciousness, and abdominal pain and indigestion). Logistic regression analyses were used to determine if the grouped symptoms were better predictors of diagnostic category than discrete symptoms. Although combining symptoms makes sense pathophysiologically, the analysis indicated that it did not increase predictive capability of the models beyond what was found with individual symptoms. Therefore, for simplicity and ease of interpretation, no further analysis was performed, and the results of the combined symptoms analyses will not be discussed further.

Symptom Clusters

Factor analysis was used to test whether symptoms group together (Hypothesis 4) and, if so, whether these differences remain after controlling for sociodemographic variables (Hypothesis 5). The 21 presenting symptoms were entered into a factor analysis to determine if some underlying groups of symptoms could be discerned that would be better predictors of diagnostic group than single symptoms alone. Principal components with varimax rotation was used for this analysis. A six-factor solution appeared to provide the best fit. Only symptoms that loaded at 0.4 or above were included in factors. Table 9 shows the six-factor solution.

Dyspnea and diaphoresis loaded on Factor 1. Abdominal pain, nausea, and vomiting loaded on Factor 2. Factor 3 was composed of radiating symptoms, including arm, neck, and jaw pain. Dizziness, unconsciousness, and weakness loaded on Factor 4. Chest pain loaded negatively and chest tightness and discomfort loaded positively for Factor 5. Finally, cough and headache loaded on Factor 6. As can be seen, these six factors are relatively weak predictors and, even when combined, explain only 39% of the total variance in the sample. Factor 1, the strongest factor, explained only 9% of the variance found.

Differences in Symptom Clusters Between Diagnostic Groups

The next step in analysis was to cross-tabulate the occurrences of these factors with diagnostic groups. New variables were computed from the factors to use in further analyses. Absolute numbers were used to create the variables, which were coded 0 to 3 depending on the presence of 0, 1, 2, or 3 symptoms. For example, a new variable was

Table 9

Factor Analysis of Presenting Symptoms

Symptom	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Abdominal pain	--	0.54880	--	--	--	--
Arm pain	--	--	0.43497	--	--	--
Back pain	--	--	--	--	--	--
Chest pain	--	--	--	--	-0.59792	--
Chest pressure	--	--	--	--	--	--
Chest tightness	--	--	--	--	0.42258	--
Chest discomfort	--	--	--	--	0.57333	--
Cough	--	--	--	--	--	0.71640
Dizziness	--	--	--	0.64405	--	--
Headache	--	--	--	--	--	0.48005
Indigestion	--	--	--	--	--	--
Jaw pain	--	--	0.67337	--	--	--
Neck pain	--	--	0.74551	--	--	--
Unconscious	--	--	--	0.53214	--	--
Vomiting	--	0.73482	--	--	--	--
Nausea	--	0.63203	--	--	--	--
Arm numbness	--		--	--	--	--
Palpitations	--		--	--	--	--
Dyspnea	0.69093		--	--	--	--
Diaphoresis	0.56846		--	--	--	--
Weakness	--		--	0.46381	--	--
Eigen value	1.8308	1.4186	1.3228	1.1882	1.1634	1.1056
Cumulative % variance	0.0872	0.1547	0.2177	0.2743	0.3297	0.3824

created for factors with two symptoms by assigning a value of 2, a value of 1 was assigned; and if either of the two symptoms was present, and 0 was assigned if neither was present. A similar construction was used for factors with three symptoms, except that the range was from 3 to 0. The cross-tabulations showed that the simultaneous presence of all three symptoms (two symptoms for Factors 1 and 6) was rare (Table 10). Furthermore, there were no dramatic differences in percentage of cases reporting all possible symptoms across diagnostic groups. Factor 1 was the strongest predictor with 14% of all patients reporting both dyspnea and diaphoresis. The next strongest was Factor 5, with 1.6% of all patients reporting chest pain, tightness, and discomfort. One possible limitation with this analysis is that chest pain loaded negatively on Factor 5, which made the results hard to interpret. Furthermore, it is unlikely that a patient would use all three of these descriptive terms to describe a chest symptom during a single ED visit.

Logistic regression analysis was not performed as planned on these factors because the cross-tabulations revealed so few cases with all symptoms that loaded on any particular factor.

Table 10

Cross-Tabulation of Factors (Symptom Combinations) by Diagnostic Group

	AMI/UA		Other cardiac		Other diagnosis		Released		Overall	
Symptom combinations	%	(*n*)	%	(*n*)	%	(*n*)	%	(*n*)	%	(*n*)
Factor 1 (dyspnea, diaphoresis)*										
0	37.9	(578)	39.0	(675)	41.9	(117)	60.0	(1,092)	45.9	(2,462)
1	42.4	(648)	44.3	(768)	41.9	(117)	32.9	(599)	39.8	(2,132)
2	19.7	(301)	16.7	(289)	16.3	(45)	7.4	(29)	14.3	(764)
Factor 2 (abdominal pain, vomiting, nausea)*										
0	63.6	(971)	65.6	(1136)	57.7	(161)	74.2	(1351)	67.5	(3,619)
1	28.4	(433)	26.7	(462)	26.5	(74)	18.3	(330)	24.2	(1,299)
2	7.5	(114)	7.2	(124)	11.1	(31)	6.5	(119)	7.2	(388)
3	0.6	(9)	0.6	(10)	4.7	(13)	1.1	(20)	1.0	(52)
Factor 3 (arm, neck, jaw pain)*										
0	48.3	(737)	57.1	(989)	67.7	(189)	68.7	(1251)	59.1	(3,166)
1	38.1	(586)	34.0	(588)	24.4	(68)	25.8	(469)	31.9	(1,711)
2	11.6	(177)	7.4	(128)	7.2	(20)	4.9	(89)	7.7	(414)
3	1.8	(27)	1.6	(27)	0.7	(2)	0.6	(11)	1.3	(67)

Table 10 (Continued)

Symptom combinations	AMI/UA %	AMI/UA (*n*)	Other cardiac %	Other cardiac (*n*)	Other diagnosis %	Other diagnosis (*n*)	Released %	Released (*n*)	Overall %	Overall (*n*)
Factor 4 (dizziness, unconsciousness, weakness)*										
0	84.7	(1,293)	78.8	(1,365)	73.5	(205)	85.1	(1,548)	82.3	(4,411)
1	13.1	(200)	18.8	(314)	22.9	(64)	12.9	(234)	15.2	(812)
2	1.9	(29)	2.8	(49)	3.6	(10)	1.9	(35)	2.3	(123)
3	0.3	(5)	0.2	(4)	0.0	(0)	0.2	(3)	0.2	(12)
Factor 5 (chest pain [-],ᵃ tightness, weakness)*										
0	6.1	(98)	8.7	(151)	15.4	(43)	7.7	(140)	8.0	(427)
1	72.9	(1,113)	68.4	(1,184)	64.5	(180)	70.4	(1,281)	10.1	(3,758)
2	19.0	(290)	21.3	(368)	20.1	(56)	20.5	(373)	20.1	(1,087)
3	2.0	(31)	1.7	(29)	0.0	(0)	1.4	(26)	1.6	(86)
Factor 6 (cough, headache)*										
0	92.3	(1,409)	86.8	(1,503)	82.4	(230)	76.7	(1,396)	84.7	(4,538)
1	7.4	(113)	12.8	(221)	17.6	(49)	20.9	(380)	14.2	(763)
0	0.3	(5)	0.5	(8)	0.0	(0)	2.4	(44)	1.1	(57)

Note. AMI -- acute myocardial infarction; UA = unstable angina.
ᵃ -- negative value.
*Statistically significant difference at $p \leq 0.001$.

DISCUSSION

The results from this population-based study of ED patients with possible AMI UA provide evidence for differences in symptom presentation among sociodemographic subgroups and diagnostic categories. Although several studies have reported on chest pain patients presenting to EDs, most previous studies were based on data collected during the 1980s in the Northeastern United States, primarily as part of the Chest Pain Study (Goldberg et al., 1998; T. H. Lee, et al., 1987, 1992), or in Sweden (Herlitz et al., 1992; Herlitz et al., 1995; Karlson, Herlitz, et al., 1997; Karlson et al., 1991). The studies examining Swedish patients may not be generalizable to the U.S. population given the differences in health care access and in patient demographic profiles between the two countries. Several U.S. studies have addressed symptom presentation and delay time in ED patients, but most were limited to a particular hospital or only a few cities or regions of the country, possibly also limiting the generalizability of the results. Subjects included in the Chest Pain Study, for example, were drawn from a limited geographic area (Johnson et al., 1993; T. H. Lee et al., 1987, 1992). A further limitation is that the majority of the U.S. studies were based on small samples with little or no ethnic diversity. Thus, the results may not be applicable to the U.S. population as a whole.

In an earlier study, Goldberg et al. (2000) reported on symptom presentation in REACT patients who were diagnosed with AMI or UA. The present study, however, includes REACT patients regardless of diagnosis. Examination of symptom presentation by diagnostic group in a large ethnically and regionally diverse sample of patients provided data that may be more relevant across EDs with geographic, ethnic, and other sociodemographic diversities. The data presented here provide a recent description of ED patients approximately 6 to 10 years after most of the previous studies. Unfortunately, study eligibility criteria required that all patients present with chest pain or other chest symptoms, limiting generalizability of the results. The seriousness of this limitation is shown by a recent study by Canto and colleagues (2000) that found 33% of AMI patients did not present with chest pain even though chest pain was broadly defined to include arm, neck, and jaw pain in addition to other chest symptoms.

Tremendous changes have occurred in diagnosis and treatment for AMI since the 1980s when most of the previous studies were conducted. The new treatments are most effective if delivered closely following AMI onset (GISSI, 1986; ISIS-2, 1988), making patient delay a significant recent factor in outcome. Patient delay is the largest component of delay in patient treatment, and some studies suggest that women, minorities, and the elderly delay longer in seeking care compared to men, Whites, and younger people (e.g., Dracup & Moser, 1997; Ell et al., 1994; Raczynski et al., 1994). Several studies have found that, after accessing care, women and minority AMI patients may not be diagnosed as quickly and may not be treated with some therapies as often as White males (Barron et al., 1998; Taylor, Canto, Sanderson, Rogers, & Hilbe, 1998; Vaccarino, Parsons, Every, Barron, & Krumholz, 1999). Results from the present study may help to increase awareness of differences in presentation by sex and ethnicity among clinicians, which could result in earlier treatment for some AMI/UA patients. These data may provide useful information to health educators and others concerned with educating high-risk patients and community members to respond appropriately when experiencing symptoms of a possible AMI. Early response for AMI would improve treatment options and possibly reduce AMI-related morbidity and mortality.

This study presents evidence for differences in diagnostic group assignment and in presenting symptoms in a selected sample of patients who presented to the ED with chest pain or other chest sensations. Although all patients presented with presumptive AMI/UA, the diagnosis was confirmed in only 43% of admitted patients. Almost half of all admitted patients were subsequently diagnosed with some other cardiac disease.

The rate of diagnosed AMI/UA in this study was lower, and the rate of diagnosis for Other Cardiac disease was higher than those reported in a previous study (T. H. Lee et al., 1992). Because of changes in coding regulations and diagnostic criteria for AMI, the study results may not be directly comparable, but differences between the studies can still be informative. The inclusion and exclusion criteria for the T. H. Lee et al. (1992) study were similar to those for the REACT trial. In the earlier study, long-term survival in ED patients presenting with acute chest pain as a chief complaint was examined using data collected from one northeastern hospital between 1984 and 1986. The authors report that 52% of admitted patients were diagnosed with AMI or UA, and only 13% were diagnosed with some other (non-AMI) cardiac condition (T. H. Lee, et al., 1992). In the present study, 43% of admitted patients were diagnosed with AMI/UA, and 49% were diagnosed with some other cardiac condition. The 8% rate of noncardiac diagnosis among admitted patients in the present study was lower than the 34% reported by T. H. Lee et al. (1992).

The years between the two studies have brought many changes in coding regulations and also major advances in diagnosis for AMI/UA, which may account for the differences found. The increasing complexity of coding regulations may have resulted in more mis-coding of events in the present study. The definition of what constitutes AMI/UA has been refined and made more precise in the intervening years, which alternatively may have resulted in fewer miscoded events. The high proportion of patients diagnosed with an Other Cardiac disease in the present study together with the low proportion of non-cardiac diagnoses may be a consequence of these changes. It may be, also, that these and other changes have resulted in physicians, at least those in the REACT study, becoming more conservative in making clinical assessments in emergency settings.

Hypothesis 1 proposed that there would be significant differences in diagnostic category based on sex, ethnicity, and age group, with males, Whites, and older patients being diagnosed more often with AMI/UA. As hypothesized, men were more often admitted to the hospital and diagnosed with AMI/UA compared to women. Although males and females in this population presented to the ED in nearly equal proportions, women were released to home more often than men. This is consistent with some previous research (Cunningham et al., 1989) of undertreatment of female patients (Barron et al., 1998; Kudenchuk et al., 1996; Roger et al., 2000) compared to male patients. In the present study, physician bias or preconceptions about the risk profile of AMI patients cannot be entirely ruled out as an explanation of some portion of the observed differences. Patients were not followed after their ED or hospitalization event; thus, it was not possible to determine if women were more likely to be misdiagnosed and inappropriately sent home from the ED compared to men. The more parsimonious explanation, however, is that the male to female differences in rates of hospital admission and AMI/UA diagnosis found in this study result primarily from the overall higher rate of AMI among men.

Women were less likely to be admitted and diagnosed with AMI/UA simply because they had fewer heart attacks than men. In the absence of definitive evidence of an AMI, the decision to admit patients is somewhat subjective, perhaps resulting in fewer women being admitted to the hospital. The final diagnosis of AMI, however, is usually objective. That there were no statistically significant differences between men and women in the Other Cardiac and Other diagnostic categories suggests that women were being correctly diagnosed once admitted.

As hypothesized, Whites were more likely to be hospitalized and diagnosed with AMI/UA compared to minorities. Intragroup demographic characteristics, such as the generally younger age and the greater proportion of females among minority patients, may account for much of the differences found here. No adjustment was made for age or sex in the univariate analysis of diagnostic groups by ethnicity. Support for the influence of age and sex on the results comes from the multicenter Chest Pain Study that found Black AMI patients were significantly more likely to be female and were 5 years younger, on average, compared with Whites (Johnson et al., 1993). In the present study, females and younger patients were less likely to be diagnosed with AMI/UA or Other Cardiac diseases and were more likely to be sent home from the ED compared with males and older age groups. These factors most likely are reflected in the results. As with differences based on sex, lack of follow-up information precludes any determination of the appropriateness of these patients' final dispositions.

An additional source of variation may be related to sex and ethnic differences in symptom presentation. Evidence from this and other studies suggests that minorities and women are more likely to present with atypical symptoms (Clark et al., 1989; Everts et al., 1996; Goldberg et al., 1998; Johnson et al., 1993; D. Maynard et al., 1997; Meischke et al., 1998; Taylor et al., 1998). Atypical symptoms may result in these patients being released from the ED more often than White males.

Other studies have reported that minorities are less likely to be hospitalized (Johnson et al., 1993), and that admitting physicians are less likely to suspect AMI in Black patients (Taylor et al., 1998) compared to Whites. It is possible that some part of the differences in hospital admission status may be due to health disparities and inequalities in access and treatment among some sociodemographic subgroups as has been reported by other researchers (Blustein & Weiss, 1998; Daumit, Hermman, & Powe, 2000; Dressler, 1993; Karlson et al., 1993; Kudenchuk et al., 1996; U.S. Department of Health and Human Services, 1985, 1991; Wolfson, Kaplan, Lynch, Ross, & Backlund, 2000). Future studies are needed to examine these factors more closely to determine how much of the ethnic variation in diagnostic categories can be accounted for by age and sex differences in rates of AMI and how much, if any, reflects unequal access to care. It will be particularly important to examine AMI/UA patients who present without chest pain to determine if presenting symptoms in these patients differ by sociodemographic characteristics.

As hypothesized (Hypothesis 1), the rates of diagnosed AMI/UA increased with age. This finding is consistent with other research (Solomon et al., 1989). In the present study, AMI/UA rates were lowest in the under 40 years age group and rose with age. The highest rate of AMI/UA diagnosis was found in the oldest age group (≥ 80 years). Although at the highest risk for AMI/UA, the oldest patients were slightly less likely than patients aged 60 to 79 years to be admitted and diagnosed with Other Cardiac disease. The 80 years and older age group was also the least likely of all age groups to be given an

Other diagnosis. Patient disposition in this age group is consistent with the positive correlation found between age and heart disease (American Heart Association, 1997; Ciccone et al., 1998).

Patients in the 80 years plus age group were more often released to home from the ED compared with patients aged 50 to 79 years. Older patients were more likely also to present with atypical symptoms (in addition to chest symptoms), which may have resulted in their being released to home inappropriately. Some component of the higher rate of release among elderly patients may be related to reluctance by clinicians to treat these patients aggressively. Studies have shown that AMI patients aged 75 years and older are less likely to receive thrombolytic therapies or revascularization procedures compared with younger patients (Barron et al., 1998). These differences may be explained in part because of the higher risk of such therapies on older people. It is possible, however, that the higher rate of release among the oldest patients is associated with a greater probability of atypical symptom presentation. If older patients were presenting with atypical symptoms, it may have resulted in their being inappropriately released to home rather than admitted to the hospital.

A three-way interaction was found among diagnostic categories by sex and age group and may reflect demographic characteristics among the groups. These differences probably resulted from the overrepresentation of females in the oldest age groups in all diagnostic categories. Men were more likely than women to be admitted and diagnosed with AMI/UA at younger ages, but the reverse occurred in the two oldest age groups. A similar pattern was found among patients diagnosed with Other Cardiac disease. These results confirm earlier findings of a 7 to 9 year age gap between male and female patients with AMI (Cunningham et al., 1989; Meischke et al., 1998). The age differences by diagnostic category found in this study probably reflect the lower risk for heart attacks among premenopausal women combined with their greater overall longevity compared with men.

Overall, the results of the analysis of diagnostic groups and sociodemographic characteristics show differences in diagnostic category based on sex, ethnicity, and age group. The results support the hypothesis that AMI/UA patients are more likely to be White and male compared with minorities and women. AMI/UA patients also tended to be older than patients in all other diagnostic categories. As age increased, the proportion of females rose among AMI/UA patients. This is consistent with later age of onset of AMI among women.

As proposed in Hypothesis 2, this study found differences in symptom presentation by sex, ethnicity, and age group among patients with chest symptoms presumptive of AMI. Some differences persisted after controlling for diagnostic group. These differences may be underestimated because of the stringent criteria used to assess statistical significance ($p \leq 0.002$). Further, this study was limited to patients presenting with chest pain or other chest sensations. Canto et al. (2000) found that, among National Registry of Myocardial Infarction 2 (NRMI 2) patients, one third did not report chest pain on presentation even though the symptom was defined broadly to include chest pressure, discomfort, or sensation and jaw, neck, or arm pain. Canto and colleagues (2000) reported that women and older patients were more likely to present without chest pain, as were patients with diabetes.

Other studies have reported differences in symptom presentation by sex, ethnicity, and age group (Ciccone et al., 1998; Clark et al., 1989; Everts et al., 1996; Goldberg et al., 1998, 2000; H.-O. Lee, 1997; Lisiani et al., 1992; D. Maynard et al., 1997; Mieschke et al., 1998; Raczynski et al., 1994; Solomon et al., 1989). Goldberg et al. (2000) found that, among REACT patients, females with AMI were more likely to report vomiting, and those with UA were more likely to report arm, jaw, and neck pain or nausea compared with males. As with the present study, however, there were no sex differences for chest symptoms, perhaps because this was an eligibility criterion. Variation among minorities in symptom presentation may be explained partially by the higher rates of hypertension, diabetes, or other diseases among some ethnic groups. Raczynski et al. (1994) found that being White and having a diagnosis of coronary heart disease, among other factors, were associated with reporting painful symptoms. Some authors have suggested that differences in symptom reporting may be due to cultural and social factors (Bates et al., 1993; Gibson et al., 1994; McGarth, 1994). Language or cultural differences among the three ethnic groups could have affected both the reporting and recording of symptoms. Age differences in symptom presentation may be the result of changes associated with progression of disease or with aging. Diminished vascular capacity from some chronic diseases more common in older adults may decrease ability to detect physical sensations (Langer, Freeman, Josse, Steiner, & Armstrong, 1991; Umachandran et al., 1991). Symptom presentation differences may also be related to socially learned roles and illness behaviors which may vary by sex, ethnicity, or age.

There appears to be a need for more patient education regarding heart attack symptoms. REACT focus group participants had the expectation that heart attack symptoms would be severe and recognizable and had low perceptions of their personal risk for a heart attack (Finnegan et al., 2000). Older people in particular may lack knowledge of heart attack symptoms. In a random-digit dialed telephone survey conducted as part of the REACT Study, knowledge of AMI symptoms was low among residents in the study communities. Respondents aged 55 years or older, however, reported fewer correct symptoms of AMI compared to younger residents (Goff et al., 1998). These results suggest that members in the study communities could benefit from an appropriately designed educational intervention to raise their awareness of AMI symptomatology. Specific information on typical and atypical presentations of AMI and the greater risk of atypical presentations faced by some demographic subgroups may help with the design of more appropriate and targeted community education campaigns to reduce care seeking delay for symptoms of AMI.

More information on demographic differences in symptom presentation may be helpful to emergency care providers for patient triage and disposition. Interventions that target ED and other health care providers may also improve outcomes caused by possible missed or delayed diagnosis resulting from atypical symptom presentations more common in some segments of the population.

Hypothesis 3 proposed that radiating symptoms, chest pressure, diaphoresis, and dyspnea would be predictive of an AMI/UA diagnosis. The generalizability of these results is limited by the study admission criteria, and these findings may not be indicative of differences in AMI/UA presentation among patients who do not present with chest pain. Furthermore, although some symptoms showed strong adjusted odds ratios associated with particular diagnostic categories, overlapping confidence intervals made it impossible to select one symptom or combination of symptoms as being predictive of a particular diagnosis. Nevertheless, some symptoms persisted after controlling for potentially confounding factors found to affect symptom presentation in the univariate analysis.

Symptoms reported by AMI/UA versus all other patients did not differ dramatically from those by admitted compared to released patients (Figures 7-9). In both sets of analyses, admitted and AMI/UA patients reported more chest pressure, arm and jaw pain, nausea, and diaphoresis and less abdominal pain and cough than their respective comparison groups (e.g., released patients or all other patients). Admitted patients were more likely to report dyspnea than released patients, but this symptom did not differ between AMI/UA and all other patients. It appears that, although dyspnea is a common symptom of AMI/UA, in this sample of presumptive AMI patients it distinguishes only admitted patients, perhaps reflecting physicians' cognizance of it as symptomatic of AMI. Overall, these results suggest that there is a relative consistency in decision making among ED physicians as to admission criteria in patients presenting with chest pain. No information was available on the appropriateness of admissions for diagnoses other than AMI/UA, but the low percentage of admitted patients in the Other diagnostic category indicates that physicians were correctly identifying admitted patients with CVD. Cases for this study were all selected based on a symptom presentation consistent with presumptive AMI: thus, clinicians were admitting patients with the highest probability of a cardiac diagnosis.

The analysis of AMI/UA patients versus all others showed that arm, jaw, and neck pain; chest pain and pressure; nausea; and diaphoresis were all positive predictors of AMI/UA. Virtually all patients, regardless of ultimate disposition, would have been enrolled to the study based on a reported chest symptom and presumptive AMI. Thus, chest symptoms are unlikely to be helpful in distinguishing diagnostic categories in this population. Abdominal pain, cough, and palpitations were negative predictors of AMI/UA. These symptoms, minus chest pain but including unconsciousness and dyspnea, were also positive predictors of hospital admission and were not restricted to patients diagnosed with AMI.

Only chest pressure and dyspnea were positive predictors of Other Cardiac disease when compared to all other patients. The Other Cardiac category contained a number of different cardiac diseases that may have widely differing presenting symptoms. No analysis was done regarding differences in symptom presentations in these diseases. Nevertheless, it is likely that some symptoms may be more prevalent in particular cardiac diseases (e.g., shortness of breath with congestive heart failure). Combining different diagnoses may have obscured the symptom profile for different types of coronary heart disease. These results emphasize the difficulties inherent in educating patients to appropriate emergency care seeking behaviors based on possible cardiac symptoms.

The logistic regression analysis of diagnostic categories in paired combinations (Tables 7 and 8) showed statistically significant differences between all pairs after controlling for community, sex, ethnicity, and age group. Once again, overlapping confidence intervals made it difficult to determine predictive symptoms distinct for each group. Jaw pain, chest pressure, and diaphoresis were positive predictors for an AMI/UA or Other Cardiac diagnosis compared with Released patients (Table 7). AMI/UA patients had more diaphoresis compared to patients with an Other Cardiac diagnosis (Table 8). However, diaphoresis was also a positive predictor for an Other Cardiac diagnosis when this group was compared with Released patients. Cough was a negative predictor of AMI/UA for all comparisons but was a positive predictor for an Other versus an Other Cardiac diagnosis. Abdominal pain was a strong negative predictor of a cardiac diagnosis or for hospital admission. This finding was consistent across all diagnostic groups except for the Other versus Released comparison. Again, when interpreting these results, it should be noted that they reflect study selection criteria and not necessarily actual differences in symptom presentation for all presumptive AMI/UA patients.

One potentially important finding in these analyses was the absence of indigestion and arm numbness as significant symptoms, because they are considered to signal possible AMI/UA by patients (Goff et al., 1998) and clinicians (Pasternak et al., 1992). Indigestion differed significantly by ethnicity in the univariate analysis and was reported as a symptom by only 2.5% of patients. Less than 1% of Hispanics reported indigestion, which probably caused the difference by ethnicity to be statistically significant. Arm numbness was reported by 7.1% of patients and differed by age in the univariate analysis only. Although these symptoms cannot be ignored, it may be that they can be emphasized less than other more common atypical symptoms when designing an intervention to reduce care seeking delay. Having fewer symptoms to address would help to simplify the message. Fewer symptoms overall means a less diffuse message and makes it easier to specify those symptoms, typical and atypical, that are most predictive of AMI/UA.

Hypotheses 4 and 5 proposed that symptoms would cluster together and that these clusters would differ by sociodemographic characteristics and diagnostic categories. Factor analysis revealed some symptom clusters that could be interpreted in terms of suspected outcomes; however, the factors had low explanatory power.

Nevertheless, the symptom aggregations into factors approximated diagnostic categories. Dyspnea and diaphoresis, both good indicators of possible heart failure, loaded as Factor 1. Abdominal pain clustered with vomiting and nausea to create Factor 2, which may be more suggestive of gastrointestinal diseases than of a cardiac diagnosis. Arm pain loaded with jaw and neck pain on Factor 3. The radiating symptoms that loaded on Factor 3 are indicators of a possible cardiac event. Factor 4 in the present analysis included dizziness, unconsciousness, and weakness. These symptoms are not specific but may signal a possible cardiac-related event, such as congestive heart failure or stroke, as well as other noncardiac diseases. Chest pain loaded negatively and chest tightness and discomfort loaded positively on Factor 5. This factor may be indicative of either an AMI UA or respiratory condition. Headache and cough loaded on Factor 6 and may indicate a noncardiac diagnosis.

The six factors in the current analysis are of doubtful value either in a clinical situation or for designing community interventions, given their lack of strength and explanatory power. The proportion of patients reporting all symptoms in a particular symptom cluster was very small, and the primary difference appeared to be between cases with none of the symptoms in the cluster or those reporting one or more. These results indicated that the factors would not be helpful for diagnostic or educational purposes.

Study Limitations

Restricting data collection to patients with chest sensations may have omitted AMI UA patients with atypical symptoms, disproportionately excluding women, minorities, and elderly patients from the study. This would have resulted in an underestimation of differences in symptom presentation among these groups. Further, AMI/UA patients who did not present with a chest symptom would also have been excluded from the study, and no data were collected on the extent to which this might have occurred. AMI/UA patients who presented without chest pain may show an entirely different symptom profile compared with patients included in this study. Thus, the results may not be generalizable to all AMI/UA patients.

The data used for these analyses were limited to cases with a recorded ethnicity of White, Black, or Hispanic. The large percentage of cases with missing data for ethnicity may have affected the results, particularly given that most of the cases with missing ethnicity came from one area of the country (Table 1). Community demographic profiles shown in Table 2 suggest that, had ethnicity been available, this information would have had the greatest effect on the proportion of patients in the Other ethnicity category. Although the patients dropped from the sample did not differ by sex, age, and marital status, there were significant differences for employment between patients with and without reported ethnicity.

The White sample was considerably larger than that for Blacks or Hispanics. It is possible that the sample size for Whites was large enough to show associations by ethnicity but that the smaller sample of minorities precluded detection of significant variation. The symptom differences that were found by ethnicity, however, were robust and may signal underlying differences in symptom reporting or presentation among minority groups.

Even among patients with recorded race or ethnicity, there is great potential for mislabeling or imprecision in specification of this variable. Race or ethnicity is a socially defined, not solely a biological, characteristic (Crews & Bindon, 1991) and, as such, is subject to error in reporting and recording. The problems with using race or ethnicity data for research purposes have been well documented (Cooper, 1984; Crews & Bindon, 1991; Hahn, 1992; Herman, 1996; Osborne & Feit, 1992) and will not be discussed further here.

As in any study relying on recording and abstraction of data, particularly when the data comes from sources not designed for that purpose, there is potential for data to be omitted, misrecorded, or coded incorrectly. These problems are compounded in cases of self-report where misunderstanding or misinterpretation by the recorder may occur. In addition, the symptoms reported by patients may have been influenced by questions from ED physicians and nurses during triage and assessment. These sources of error are compounded in multicenter trials. The study involved multiple hospitals across the United States with numerous ED personnel and data abstractors at each site. Despite training for ED personnel and data abstractors, intersite and intrasite variations in the reporting, assessment, recording, and abstraction of data may have affected the results. Given the nature of the data gathering process, it is possible that the level of reliability was such that it was impossible to detect associations or effects that may, in fact, exist.

Finally, the community was the unit of randomization for the study. Community was controlled for in the logistic regression but not in univariate analysis. Thus, unmeasured and unknown confounders could account for some of the differences found.

Implications

Studies of symptom presentation and diagnosis are important for clinicians in that the results may influence assessment procedures for patients. Peterson and Alexander (1998), commenting on the Goldberg et al. (1998) study on variation in AMI symptom presentation by sociodemographic characteristics, suggest that ED personnel need continual reminders of these possible effects. They note that these reminders can help clinicians maintain heightened suspicion that could lead to earlier diagnosis and administration of life-saving treatments.

Results from the present study showing variation in symptom presentation by sex, ethnicity, and age emphasize the difficulties inherent in clinical decision making in emergency situations and the need for appropriate triage and diagnostic assessments. Despite study limitations, the results provide support for differences in symptom presentation by demographic characteristics and by diagnostic category among ED patients with chest symptoms suggestive of AMI. The results also show the need for clinicians to be alert for possible atypical presentations of AMI/UA in some groups. In this study, women and younger patients were more likely to be released to home from the ED. Female AMI patients younger than 74 years have a higher mortality than similarly aged males (Vaccarino et al., 1999). If women do present more often with atypical symptoms as reported by this and other research, the possibility exists that younger women were being released to home inappropriately, increasing their risk for a poorer outcome.

The self-regulatory model for health care seeking behavior has implications for the present study for explaining differences in symptom presentation (Cameron et al., 1993; Pennebaker, 1982, 1994). People's cognitive representations of their symptom(s) and their appraisal of the success or failure of the coping strategies to deal with the threat could have affected who sought care and what symptoms were reported and recorded. More severe or typical symptoms promoted care seeking but may have affected symptom reporting by blocking patient recall of milder symptoms. Furthermore, if the patient reported symptoms that he or she interpreted as most serious while ignoring others, this could have affected clinician behavior in patient testing, treatment, or disposition by affecting expectations in favor of a particular diagnosis. These problems would have been accentuated if the observed differences in symptom presentation among particular socio-demographic subgroups resulted in differential care seeking behaviors or symptom reporting. Thus, symptom reporting and recording based on an incorrect cognitive representation could have influenced study results.

The ambiguity of AMI/UA symptoms makes it difficult for the individual undergoing the event to develop an appropriate cognitive representation of the health threat and determine a course of action based on that representation. Health educators and community interventionists need to understand how individuals develop illness representations, coping procedures, and appraisal processes when they experience symptoms and to develop messages to target these areas. The present study provides some information on symptom presentation and AMI symptomatology that may be helpful for developing interventions to initiate appropriate care seeking behavior for symptoms of possible AMI. Messages will need to be carefully crafted, however, to produce the desired results of stimulating appropriate care seeking without the adverse consequence of overburdening the emergency care system.

Part of the difficulty with developing messages is that people often believe they would know if they were having an AMI although they readily agree that other people do not know (H. Leventhal et al., 1992). Intervention messages should stress the difficulty in determining whether a heart attack is in progress, given the diverse nature of symptom presentation. Although knowledge of AMI symptoms does not necessarily translate into action in the presence of ambiguity of type, intensity, and duration, having more specific information should help with symptom appraisal and interpretation of possible cardiac events and, thus, may promote more appropriate care seeking behaviors. Evidence from the present study can be used to support messages regarding the variability of AMI/UA presentation.

More studies are needed to examine presenting symptoms of all AMI/UA patients, not just those who present with chest symptoms. More specific information is needed to guide the development of targeted messages on typical and atypical manifestations of AMI/UA for specific sociodemographic subgroups. Given the magnitude of the problem, even modest changes could have a significant effect in terms of potential lives saved.

Conclusions

There are differences in symptom presentation by diagnostic category and by socio-demographic characteristics among patients presenting to EDs with chest pain or other chest sensations. Many of these differences remain after controlling for variables found in univariate analysis to affect symptom presentation and diagnostic group assignment.

Results from this study reaffirm the importance of several symptoms other than chest pain for assessing presumptive AMI/UA patients in emergency situations and may be of some assistance in distinguishing patients with AMI/UA or other cardiac diseases from other, perhaps less critically ill, patients. Fewer than half of admitted patients were diagnosed with AMI/UA despite their symptom presentation and admitting diagnosis, indicating there was a need for more specific and timely assessment tools in the ED. The large number of patients who were admitted and not diagnosed with a heart attack provides additional evidence that chest symptoms are an imprecise indicator of AMI/UA. The study results reinforce the need for clinicians to assess carefully female, minority, and elderly patients to ensure they are receiving appropriate diagnosis and care. Awareness of possible differences in symptom presentation for AMI will help with decision making regarding clinical assessments and tests for possible AMI among these groups.

These results also illustrate some of the problems inherent in developing educational interventions to reduce patient delay in care seeking for AMI/UA. Examining differences in symptom presentation and diagnostic category provides information regarding those atypical symptoms that are most broadly applicable and thus may be most useful when designing educational messages for community interventions to reduce care seeking delay. Developing a message or messages to address patient delay taking into account subgroup variation in symptom presentation in addition to other considerations will be a challenge to interventionists. Successfully incorporating this information, however, could reap dividends in reduced morbidity and mortality resulting from early intervention for AMI/UA.

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APPENDIX A

IRB PERMISSION FOR HUMAN USE

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Assurance Identification/Certification/Declaration
(Common Federal Rule)

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1. Request Type	2. Type of Mechanism	3. Name of Federal Department or Agency and, if known, Application or Proposal Identification No.
☐ ORIGINAL ☐ FOLLOWUP ☐ EXEMPTION	☐ GRANT ☐ CONTRACT ☐ FELLOWSHIP ☐ COOPERATIVE AGREEMENT ☐ OTHER ______	

4. Title of Application or Activity	5. Name of Principal Investigator, Program Director, Fellow, or Other
Community Intervention to Reduce MI Delay(REACT-Rapid Early Action for Coronary Treatment)	JAMES M. RACZYNSKI

6. Assurance Status of this Project (*Respond to one of the following*)

☒ This Assurance, on file with Department of Health and Human Services, covers this activity
Assurance identification no. M-1149 IRB identification no. 01NR

☐ This Assurance, on file with (*agency/dept*) ______, covers this activity
Assurance identification no ______ IRB identification no ______ (*if applicable*).

☐ No assurance has been filed for this project. This institution declares that it will provide an Assurance and Certification of IRB review and approval upon request.

☐ Exemption Status: Human subjects are involved, but this activity qualifies for exemption under Section 101(b), paragraph ______.

7. Certification of IRB Review (Respond to one of the following IF you have an Assurance on file)

☒ This activity has been reviewed and approved by the IRB in accordance with the common rule and any other governing regulations or subparts on (*date*) 06/23/00 by ☐ Full IRB Review or ☒ Expedited Review

☐ This activity contains multiple projects, some of which have not been reviewed. The IRB has granted approval on condition that all projects covered by the common rule will be reviewed and approved before they are initiated and that appropriate further certification will be submitted.

8. Comments

9. The official signing below certifies that the information provided above is correct and that, as required, future reviews will be performed and certification will be provided	10. Name and Address of Institution
11. Phone No (*with area code*) (205) 934-3789 — 12. Fax No. (*with area code*) (205) 934-1301	UAB 701 South 20th Street, Suite 1120 Birmingham, AL 35294-0111
13. Name of Official: Marilyn Doss, M.A.	14. Title: Vice-Chair, IRB
15. Signature: Marilyn Doss	16. Date: 6/23/00

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APPENDIX B

PERMISSION TO USE FIGURE 1

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DISSERTATION APPROVAL FORM
DOCTOR OF PHILOSOPHY

Name of Candidate Mary Janice Gilliland

Graduate Program Health Education/Health Promotion

Title of Dissertation Differences in Diagnostic Category, Symptoms, and Sociodemographic Characteristics Among Patients Presenting to Emergency Departments with Symptoms of Acute Myocardial Infarction

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