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Heart Attack Experiences Described in Weblogs: An Analysis of Sex Differences

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Heart disease is the leading cause of death for both men and women (Kochanek, Xu, Murphy, Miniño & Kung, 2011). Every year in the United States, more than 600,000 people die from heart disease, which amounts to roughly a quarter of all deaths (Kochanek et al., 2011). Heart attacks account for a large portion of the deaths attributed to heart disease, and include sudden cardiac arrest or chronic cases of heart trouble that develop into heart attack after an extended period of time. Heart attacks affect approximately 935,000 Americans each year, with roughly two-thirds of people experiencing them for a first time (Kochanek et al, 2011). With such a high level of incidence, much research into incidence, prevalence, symptoms, and risk factors is being conducted in hopes of altering such somber statistics in the future.

What is a heart attack?

A heart attack, which may also be referred to as a Myocardial Infarction, occurs when some sort of blockage prevents blood flow to the heart for an extended period of time, to the point where the heart muscle (or parts of it) are irreparably damaged or die (Anderson, 2011). The majority of heart attacks occur when there is a blockage of blood flow to one of the coronary arteries, a vital "channel" in which blood travels (Anderson, 2011). When this happens, the heart rapidly becomes deprived of oxygen carrying red blood cells, which are absolutely essential for sustaining life and consciousness in the human body. In

as few as six to eight minutes without oxygen, the heart muscle can arrest causing the individual to die (Anderson, 2011).

Most heart attacks occur when a hard substance called plague builds up over time in the coronary arteries (NHLBI, 2012). Plaque, which is made up of various cells and cholesterol, attracts blood platelets, which over time, causes a blockage large enough to stymie blood flow to the heart . The build-up of plaque in the arteries over many years is called atherosclerosis (NHLBI, 2012).

A less common form of heart attack occurs when there is a severe spasm or tightening of one of the coronary arteries. The spasm cuts off blood flow to the heart and causes oxygen deprivation. Spasms can occur in coronary arteries with no signs of atherosclerosis (NHLBI, 2012).

.Symptoms

There is a wide array of symptoms for heart attack that may or may not appear in a particular individual. The extensive list and presentation of symptoms can make it difficult for individuals to realize they are having a cardiac arrest, which is problematic because time is of the essence when diagnosing and treating heart attacks.

Previous research regarding gender differences in symptoms for heart attack had been primarily conducted in the hospital setting as opposed to in primary care clinics, which thereby misses a significant number of patients who report less serious symptoms (Bosner S. et al., 2009). This study intended to analyse gender differences in aetiology and clinical characteristics of chest pain to provide gender related symptoms associated with heart attack in a primary

care setting. A total of 1,212 consecutive patients with chest pain were used in this study, all of whom were 35 years of age or older and were seen by one of 74 general practitioners. The physicians recorded the symptoms and diagnosis of each patient. For chest pain, men were significantly more likely to exhibit the symptom than women (women 9.1%, men 25.0%, and p=0.01). For pain, women were more likely to be having a heart attack if their pain duration was greater than one hour, whereas men were more likely to be having a heart attack in their pain duration was less than one hour. Women also tended to have more stinging pain, yet men had more pain associated with breathing (inhaling) and localized muscle tension.

The authors recommended further research to see whether different medical approaches ought to be taken in regard to diagnosing heart attacks in patients of either gender.

A study published in the American Heart Journal in 2004 reported that medical professionals recognize that there exists a distinct and dangerous gap in what the general population believes to be a symptom of a heart attack (most likely an influence of mass media) and what is in fact a symptom of a heart attack. This is a very serious public health concern because successful outcomes for heart attack patients are largely dependent upon timely recognition of symptoms and early medical intervention.

This study was conducted using the 2001 Behavior Risk Factor Surveillance System, which is a type of telephone survey (Greenlund, Keenan, Giles, Zheng, Neff, Croft, and Mensah, 2004). There were 61, 018 participants,

hailing from 17 states in the continental U.S. and the Virgin Islands. Participants were asked to identify whether pain or discomfort in the jaw, neck, back; feeling weak, lightheaded, faint; chest pain or discomfort; sudden trouble seeing in 1 or both eyes (false symptom); pain or discomfort in the arms or shoulder; shortness of breath were heart attack symptom. They were also asked to indicate what the first course of action should be if someone suspects that he or she is having a heart attack.

The vast majority of study participants (95%) correctly identified chest pain as a symptom of a heart attack (Greenlund et al., 2004). Alarmingly, however, only 11% of participants were able to correctly identify all of the symptoms that could be indicative of a heart attack as well as knew to call the paramedics immediately upon suspicion of a heart attack. The implications of this are that for individuals who do not know the symptoms of heart attack, there is a great chance that medical treatment will not be sought. This is a major public health concern that is in dire need of being addressed.

Symptoms of heart attacks
• Chest pain or discomfort. This involves uncomfortable pressure, squeezing, fullness, or pain in the center or left side of the chest that can be mild or strong. This discomfort or pain often lasts more than a few minutes or goes away and comes back.
• Upper body discomfort in one or both arms, the back, neck, jaw, or upper part of the stomach.
• Fullness, indigestion, or choking feeling (may feel like “heartburn”)
• Shortness of breath, which may occur with or before chest discomfort.
• Nausea or vomiting,
• Light-headedness or sudden dizziness, or breaking out in a cold sweat.
• Sleep problems, fatigue (tiredness), and lack of energy.
• Rapid or irregular heart beats

Table 1. Symptoms reported for patients diagnosed with heart attack. (NHLBI, 2012 & Cleveland Clinic, 2012)

Although all of these symptoms have been reported in cases of heart attack, many are also common in other, less fatal conditions. This can cause confusion for both the patient and physician.

Recent studies have shown disconcerting data regarding discrepancies in symptoms between men and women. In a study performed by the National Institute of Health, 515 women who were diagnosed with a Myocardial Infarction (MI), presented with generally unrecognized symptoms. These included unusual fatigue (70.6%); sleep disturbances (47.8%), shortness of breath (42.1%), indigestion, and anxiety. Of these women, 95% claimed to have experienced one or more of these symptoms up to a month prior to their heart attack (NHLBI, 2012). Although these symptoms have been on rare occasions reported in patients who were diagnosed with heart attack (NHLBI, 2012 & Cleveland Clinic, 2012), they can also be attributed to a variety of far less serious conditions, and can lead physicians to erroneous diagnoses.

One possible explanation for the less classically recognized symptoms in women as opposed to the fairly common symptom of chest pain in men may be that women tend to not have blockages only in main arteries (Cleveland Clinic, 2012). They can also have blockages in smaller arteries as well. As a result, many women arrive at the hospital after having already incurred major damage to the heart muscle because they did not recognize their symptoms as being life-threatening (Mayo Clinic, 2012).

Scientists in Massachusetts also looked at the difference in symptom presentation between men and women for AMI (Goldberg, O'Donnell, Yarzebski, Bigelow, Savageau, Gore, 2012). The goal of this study was to specifically examine any sex differences that occurred in the presentation of symptoms for an AMI. Previous studies have primarily studied gender differences in diagnosis,

management, and mortality for AMI. The participants for this community-based study were all diagnosed with AMI and selected from one of 16 metropolitan Worcester, Massachusetts hospitals. There were 810 men and 550 women in the study, all of whom had been hospitalized due to AMI between the years of 1986 and 1988. Variables such as age, medical history, and AMI characteristics were controlled via regression modeling (Goldberg, 2012).

The results showed that men were significantly less likely to complain of pain in the neck, jaw, or back or nausea than women ($p<0.05$) (Goldberg,2012). On the other hand, men were much more likely to report symptoms such as diaphoresis than women ($p<0.05$) (Goldberg, 2012). Unlike the findings suggested by some other studies, chest pain was not found to be significantly different in terms of frequency in men and women. These results indicate that there is a difference in symptom presentation between men and women for AMI. The implications of this study suggest that changes may need to be made in the methods of diagnosing patients, particularly for women who present less common symptoms for AMI.

Female Risk factors and treatment for MI

Another study examined the prevalence, clinical presentation and mortality of MI patients who presented with and without chest pain (Canto, Shlipak, Rogers, et al., 2000). As mentioned, chest pain is often considered to be a hallmark symptom for heart attacks or MI. However, there are a significant number of patients who are afflicted with a MI who do not experience chest pain.

The goal of this study was to begin to research the extent to which this happens and perhaps why this phenomenon occurs at all.

A large sample size of 434,877 patients was analyzed, all of who had a confirmed MI diagnosis between June 1994 and March 1998 (Canto, 2000). The results showed that of these patients, 33% did not present with a symptom of chest pain (Canto, 2000). These patients were, on average, seven years older than those with chest pain (74.2 as opposed to 66.9 years), as well as more likely to be female (49.0% women vs. 38% men), and have a secondary medical condition such as Diabetes mellitus (32.6% vs. 25.4%), or prior experiences of heart arrest (26.4% vs. 12.4%, Table 2). All of these conditions, including that of being female, were identified as risk factors for heart attack (Table 3). Perhaps the most alarming distinction between MI patients that did not experience chest pain and MI patients who did, was that the patients without chest pain had a considerably longer delay between onset of symptoms and seeking of treatment (average of 7.9 vs. 5.3 hours), and were significantly less likely to receive the correct diagnosis of MI (22.2% vs. 50.3%). As such, these patients were much less likely to receive the appropriate medical treatment for their health crisis.

For example, patients who presented without chest pain as a symptom received thrombolysis or primary angioplasty 25.3% of the time as opposed to those who presented with chest pain received these treatments 74.0% of the time (Canto, 2000). Aspirin, Beta-blockers, and heparin were given to patients without chest pain 60.4%, 28.0%, and 53.4% of the time (respectively), whereas patients with chest pain received the same medications 84.5%, 48.0%, and

83.2% of the time (Canto, 2000). This study ultimately indicated that patients with MI who present without chest pain represent a large proportion of the cardiac population, yet are significantly more likely to have a delay in appropriate treatment, be misdiagnosed, and ultimately have a higher rate of in-hospital mortality.

Variable	Without Chest Pain	With Chest Pain
No. (%) of patients	142,445 (33)	292,432 (67)
Age, mean (median)	74.2 (76.0)	66.9 (68.1)
Women	49.0	38.0
Diabetes mellitus	32.6	25.4
Prior heart failure	26.4	26.8

Table 2. Characteristics of Patients Presenting Without and With Chest Pain and Diagnosed With Myocardial Infarction During Same Hospitalization (Canto, 2000)

Risk Factor	Total No. of Patients	Without Chest Pain, %	With Chest Pain, %
Prior heart failure	73,737	51.0	49.0
Prior stroke	42,493	47.0	53.0
Age > 75 y	168,937	44.9	55.1
Diabetes mellitus	120,878	38.5	61.5
Nonwhite	50,607	33.7	66.3
Women	181,065	38.6	61.4

Table 3. Six Major Risk Factors for Presentation Without and With Chest Pain for Patients with Myocardial Infarction (Canto, 2000)

Female Mortality for MI

The Minnesota Heart Study examined gender differences in early mortality after acute myocardial infarction (AMI). Although it is widely suspected that women have an increased rate of mortality from AMI, the reasons for this trend remain largely unknown. The role of sex was studied in 1600 people from the Minnesota area (Demirovic, Blackburn, McGovern, Luepker, Sprafka & Gilbertson, 2012). The patients were aged between 30 and 74 years. A random 50% sample was taken from hospitalized patients with AMI between 1980 and 1985, with 1,168 men and 432 women. Predictors for early death among patients (28 days or less after admission to the hospital) included characteristics such as gender, age, chest pain on admission, history of previous AMI, angina pectoris, coronary artery bypass surgery or hypertension, presence of head failure,

cardiac arrhythmias requiring direct- current shock, diabetes mellitus, valvular disease, cardiomyopathy, and levels of serum enzymes and blood urea nitrogen. Even with an adjustment for age related mortality, women were still found to have a significantly higher rate of mortality. This phenomenon occurred, however, only in patients younger than 65 years old, with women's mortality at 12.5% and men's at 6.5% ($p<0.01$) in this age group. Those aged 65 and older did not show statistically significant gender effects in mortality.

Subsequently, multivariate analysis also showed that for those aged 65 years and younger, female sex was a strong independent predictor for early mortality ($p<0.01$) (Demirovic, 2012). Invasive cardiac procedures were performed more often on men than women in this sample, but after all extraneous variables were controlled, there was only a significant difference in the rate at which coronary angiography was performed in men and women (26% vs. 17%, respectively ($p<0.05$)). The Minnesota Heart Study found a greater rate of mortality in women under the age of 65 who had experienced an AMI than in male counterparts. More research is needed to further understand such trends.

Another study focused on the relationship between age and symptoms in patients with MI and any associated mortality (Canto, 2000). Previous studies have established that women are generally older than men when/if they have a MI, and are less likely to present with the classic symptom of chest pain (Canto, 2000). Very few of these studies have, however, looked at the relationship of sex differences in symptom presentation and mortality.

This was an observational study conducted through the National Registry of Myocardial Infarction from 1994-2006 (Canto, 2012). There were 1,143,513 patients in the registry, 481,581 women and 661,932 men (Canto, 2012). The study examined predictors of MI presentation without chest pain and the relationship between age, sex, and hospital mortality (Figure 1). As has been the trend with numerous other studies, more women than men presented without chest pain (42.0% vs. 30.7%, respectively, $p<0.01$) (Canto, 2012). Data showed a significant relationship between age and sex with chest pain at symptom onset, with a greater sex difference evident in younger patients rather than older patients. The in-hospital mortality rate was also found to be sizably larger for women (14.6%) than men (10.3%). Surprisingly, younger women who presented without chest pain had a greater probability of in-hospital mortality than younger men who presented without chest pain (Canto, 2012). This gender trend decreased and then reversed as age increased. In sum, this study demonstrated that women are more likely than men to present asymptomatic for chest pain when diagnosed with MI, and are more likely to die in the hospital. As age increases, however, these differences become less pronounced and ultimately insignificant.

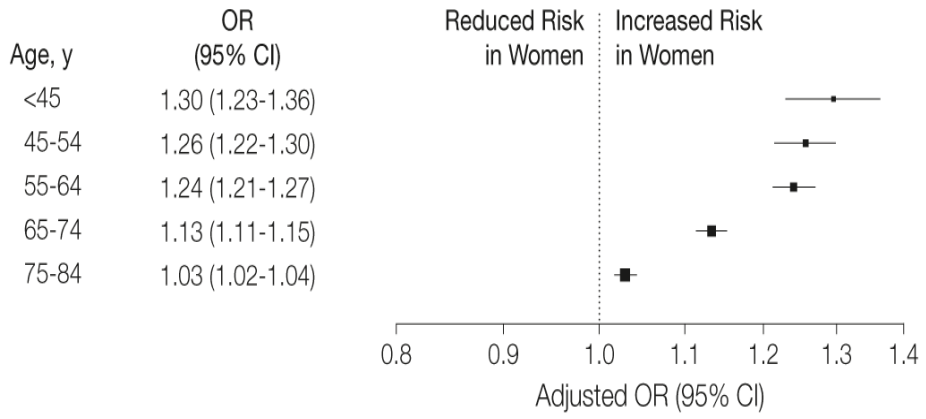

Figure 1. Sex differences in Myocardial Infarction Presentation Without Chest Pain/Discomfort, Stratified by Age (Canto, 2012)

A study conducted at McGill University in Montreal, Canada sought to identify sex differences in risk factors, symptom presentation and overall outcome for young adults with AMI. Two parallel studies were performed. The first used provincial administrative databases from Quebec, Canada from 2000 to 2007 (NCBI, 2012). This information was used to establish baseline characteristics and post-acute myocardial infarction survival of patients under the age of 50 (n=10, 619) (NCBI, 2012). The second study used a medical chart review on 215 patients less than 50 years of age from April 2000 to August 2006 from the McGill medical center (NCBI, 2012). This was done in an attempt to overcome the lack of clinical data in the administrative databases.

In the administrative study, women were much less likely than men to seek medical attention for retrosternal chest pain (pain behind the sternum that usually occurs upon swallowing) one month prior to AMI (p=0.035) (NCBI, 2012). Diabetes and hypertension were more prevalent in women, yet both genders equally received interventional procedures after their cardiac episode. Diabetes

showed evidence of being a major factor in the reduction of post-AMI survival in both men and women, and more women consequently died due to the increased prevalence of diabetes in the females of the study. Female mortality in-hospital and up to one year post-AMI was significantly higher than in men (p=0.05) (NCBI, 2012). Although the men in the study tended to be more obese, there did not appear to be any difference in sex differences in symptom presentation or interventional procedures after the AMI.

To summarize this study, young men and women were found to have equally frequent presentation of chest pain as a symptom for AMI, yet women were significantly less likely to seek medical treatment for their chest pain. Diabetes and hypertension were more prevalent in young women than young men, and more young women died from their AMI than young men. In addition to encouraging young women to seek medical assistance for chest pain, another implication of this study is that awareness of diabetes prevention should be raised, as Diabetes appears to have a significant impact on the survival rate of patients who have an AMI.

A study conducted by researchers in the Department of Epidemiology and Public Health at Yale University Medical School sought to clear up the often contradictory sets of data presented in prior studies that claim women have an overall higher rate of mortality after an AMI then do men, yet do not have adequate controls for age and other prognostic factors (NCBI, 2012). The hypothesis for this study was that younger women would have higher rates of

mortality during hospitalization than similarly aged men, yet disparities would decrease and ultimately disappear as age increased.

Data was analyzed from 384,878 patients (155,565 women and 229,313 men), who ranged in age from 30 to 89 years old (NCBI, 2012). All of these patients had been enrolled in the National Registry of Myocardial Infarction 2 between June 1994 and January 1998. (NCBI, 2012) Any patients who had been transferred from one hospital to another during their treatment for MI were excluded from the study.

Overall, the mortality rate for women was higher than that for men (16.7% vs. 11.5%) (NCBI, 2012). As predicted, the differences in these rates were dependent upon age. For women under the age of 50, the mortality rate was twice that of their male counterparts. The difference in the mortality rates decreased as age increased, and was no longer significant after the age of 74 ($p<0.01$ for the interaction between sex and age) (NCBI, 2012). By using logistic-regression analysis, researchers were able to ascertain that women in the study had an 11.1% increased risk of mortality over men with every five-year decrease in age (NCBI, 2012). Even after factors such as differences in medical history, severity of the MI, and early intervention and management were taken into account, women still had an increased chance of death for every five years of decreasing age. These other factors were found to be responsible for only one-third of the discrepancy in mortality rate between men and women, leaving women with an overall 7.0% higher adjusted mortality rate than men ($p<0.05$) (NCBI, 2012).

The Present Study

As many studies have suggested, there seems to be an alarming discrepancy in not only the symptoms experienced by women as opposed to men with MI, but also a significantly higher risk of mortality for women than men. The lack of chest pain symptom in women with MI has been studied rather thoroughly, but identification of what other symptoms are more prevalent in women is not well documented. Also, although the mortality rate for women with MI appears to be significantly higher than for men with MI in non-elderly populations, the reasons behind this phenomena have not been thoroughly studied. A possibility is that the lack of traditionally recognized symptoms in women lead to misdiagnoses and delayed treatment. There may also be a psychological component to this issue, namely that women are less apt than men to take time to go to the hospital for themselves.

This study will attempt to identify the symptoms women and men experience when having a heart attack as well as any significant correlation between the time lapse from the initial onset of symptoms to the treatment of the symptoms. There may be a trend supporting this hypothesis because many medical maladies are dependent upon time. In general, patients have the best outcomes when they are treated quickly.

The study will use *StoryUpgrade6,* a computer program designed by Dr. Andrew Gordon, Dr. Christopher Weinberg (University of Southern California), and Dr. Sara Sood (Pomona College) which sorts through over 10 million blog websites searching for terms similar to those in the training story. In this study,

we identified approximately 65 personal blog posts on the internet that describe specific individual's experiences with MI. The goal is to identify sex differences in specific symptoms as well as any relation between delayed treatment of symptoms and hospital intervention.

I hypothesize that my research will find that women present with generally less traditional symptoms of heart attack more frequently than men. As a result, there will be a longer delay between onset of symptoms and treatment because women are unaware that they are in the midst of a cardiac crisis. This increased delay time will lead to poorer overall outcomes (compared to male counterparts), and a higher rate of mortality. The significance of gender differences in symptoms, treatment delay, and mortality will decrease as age increases. This is because as people age, their general likelihood of having a heart attack increases and gender, consequently, becomes less significant.

Methods

Sampling

Heart attack experiences described in blogs were identified using a program called *Story Upgrade 6* [24]. The system is backed by a corpus containing 17.4 million blog posts during two years, 2010 and 2011, that the system recognized as English-language personal stories. To search this corpus for relevant stories, the system used a simple sample story (called a 'dummy story') that I wrote. This story was written in a style that resembled how heart attacks were described by some bloggers. It contained key words, including some traditional and nontraditional symptoms (e.g., "I felt crushing pressure in

my chest," "I felt very dizzy and could not catch my breath," "I had pain in my arm/back/jaw"), as well as "911," "emergency room," paramedics," "diagnosed with heart attack". The sample story used colloquial language typical of blogs. See Appendix I for the complete 'dummy story' used in this study.

Using the simple dummy story as a seed, *Story Upgrade 6* converted this story into a search query, enabling it to find the closest related stories from the corpus of blogs. All retrieved stories were marked as relevant if they contained information about a heart attack experience in either a first or third person account, and marked as irrelevant if the story was not about a heart attack and dropped from the analysis. I identified 65 relevant stories and 984 irrelevant stories. The program used relevant stories as they were identified to update the search query and retrieve more stories from the corpus using a process called relevance feedback. The program does so using the Rocchio algorithm to update the search query, enabling it to encode relevant and irrelevant information denoted by the users to find increasingly relevant stories. The program weights more heavily words found in relevant stories and less heavily words found in irrelevant stories. Stories that did not identify the sex of the heart attack patient or were in blogs that denied access, such as expired pages or blogs requiring a subscription or permission, were ignored by being placed in a 'skip' category. Stories placed into this 'skip' category (400 stories in this study) did not affect the Rocchio algorithm and therefore had no influence on identification of other stroke stories (Gordon, 2012).

Coding

We developed codes for first or third person narrator, whether or not a third person witnessed the event, their relation to the patient, patient sex and age, patient symptoms, assistance to obtain medical attention (e.g., 911) , delay before seeking assistance, delay at hospital, treatment and heart attack outcome. If the specific age of the patient was not available, age range was coded if information was sufficient. Patient symptoms were coded as dichotomous: present or absent. Traditional symptoms were: chest discomfort, discomfort in other areas of the upper body, shortness of breath, cold sweats, nausea and lightheadedness. Nontraditional symptoms were: Feeling of fullness, indigestion, or choking, extreme weakness, anxiety, nervousness, felt like had flu, and impending sense of doom. Identification of traditional and nontraditional symptoms were based on the American Heart Association's heart attack warning signs published on their website (NHLBI, 2012 & Cleveland Clinic, 2012) as well as symptom classifications used in previous research on sex differences. Traditional symptoms were: chest discomfort, discomfort in other areas of the upper body, shortness of breath, cold sweats, nausea and lightheadedness. Nontraditional symptoms were: Feeling of fullness, indigestion, or choking, extreme weakness, anxiety, nervousness, felt like had flu, and other symptom. Symptoms were coded that occurred at the onset of the heart attack experience until medical assistance was secured.

Statistical Analysis

Each patient whose story offered the relevant information was assigned to an age category and type of narrator, with third-person narrators categorized by whether they witnessed the heart attack and their relation to the patient. The frequency of occurrence of each traditional and non-traditional symptoms was compared by sex and by heart attack symptoms using χ^2 tests with Yates correction for cells less than 5..

Results

I obtained data from 65 heart attack stories, with 52.9% about female heart attack patients and 47.1% about male heart attack patients. All patients in these stories reported having symptoms preceding their heart attack. Of the 65 stories reporting symptoms, 22 stories included age and the age distribution by sex is shown in Table 1. Not surprisingly given the age distribution of bloggers, our sample over-represented young adults yielding more reports about patients age 18-29 years than 65 years and older. This contrasts with the monotonic increase in heart attack that occurs with age. However, 43 stories did not include age and it is unknown if the patients in these stories had a similar age distribution to Table 1.

Of the 65 stories, 50.8% were narrated by the patient and 49.2% were narrated by a third person. These percentages did not differ by sex of the patient, as shown in Table 4. When a third person was the narrator, he or she was a witness to the stroke for 29.4% of women and 32.3% of men, an insignificant difference. The majority of third person narrators were a non-relative of the

patient and the type of relation varied for men and women patients, although the results were insignificant. The narrators for men patients were more likely to be a stranger (22.6%) than a friend (3.23%) than for women patients who displayed tendencies in the opposite direction (8.82% and 11,8%, respectively) (Table 5). Neither men nor women patients had a spouse as a narrator. This could be due to the small sample size, but further research is necessary to resolve this anomaly.

Table 4. Age Distribution by Sex (n = 22)

	Women (n = 13)	Men (n = 9)
	N	N
0 - 17	1	1
18 - 29	8	5
30 - 44	3	3
45 - 64	1	N/A
65 - 75	N/A	N/A
76 - 84	N/A	N/A
85+	N/A	N/A

Table 5. Patient/Narrator Profiles by Sex (n = 65)

	Women (n = 34)	Men (n= 31)	
	N (%)	N (%)	P
Narrative Style			n/a
1st Person	24 (70.6)	21 (67.7)	
3rd Person	10 (29.4)	10 (32.3)	
Witness			n/a
Yes	1 (2.94)	0 (0)	
No	33 (97.0)	100 (31)	
Relationship			n/a
Relative	3 (8.82)	2 (6.45)	
Adult Child	2 (5.88)	1 (3.23)	**n/a**
Other	1 (2.94)	1 (3.23)	
Spouse	0 (0)	0 (0)	
Non-Relative	7 (20.6)	8 (25.8)	
Friend	4 (11.8)	1 (3.23)	n/a
Stranger	3 (8.82)	7 (22.6)	
Symptoms	34 (100)	31 (100)	1.0000

χ^2 analyses of the number of men and women experiencing specific heart attack symptoms showed two significant differences, as seen in Table 6. The largest sex differences were for chest pain (a traditional symptom) and shortness of breath (traditional symptom). These findings are consistent with other studies and indicate that women are significantly less likely to experience chest pain or

shortness of breath than their male counterparts. This has implications in terms of public health awareness, as chest pain and shortness of breath are the two most common and easily recognized symptoms of heart attack. The rate of mortality was also significant for women (p = 0.007).

Table 6. Prevalence of Heart Attack Symptoms by Sex (n =)

	Women (n = 34)	Men (n = 31)	
	N (%)	N (%)	P
Traditional Symptoms			
Chest discomfort	22 (64.7)	28 (90.3)	0.02*
Discomfort in other areas of body	19 (55.9)	21 (67.7)	0.33
Shortness of breath	4 (11.8)	14 (45.2)	0.01*
Cold sweats	11 (32.4)	10 (32.2)	1.0
Nausea	8 (23.5)	9 (29.0)	0.61
Lightheadedness	9 (26.5)	3 (9.68)	0.15
Nontraditional Symptoms			
Feeling of fullness, indigestion, or choking	3 (8.82)	4 (12.9)	0.89
Extreme weakness	2 (5.88)	1 (3.23)	0.93
Anxiety, nervousness	10 (29.4)	16 (51.6)	0.07
Felt like had flu	6 (17.6)	3 (9.68)	0.57
Other symptoms**	7 (20.6)	2 (6.45)	0.19
*to show statistical significance **(impending sense of doom, allergic reaction)			

Virtually all heart attack patients sought medical assistance (100%) regardless of sex, although only 47.1% of women patients and 51.6% of men patients received immediate medical assistance, a difference that did not reach statistical significance (Table 7). There was no sex difference in time to get treatment in the hospital with both virtually 100% of women and men patients receiving treatment immediately.

Table 7. Heart Attack/Response & Treatment Details by Sex (n varies by category)

	Women	Men	
	N/n (%)	N/n (%)	P
Incidence			n/a
First Time	34/34 (100)	27/31 (87.1)	
Recurring	0/34 (0)	4/31 (12.9)	
Outcome			
Good	29/34 (85.3)	30/31 (96.8)	
Dead	5/34 (14.7)	1/31 (3.23)	
Medical Assistance	34/34 (100)	31/31 (100)	n/a
911 / EMS	16/34 (47.1)	16/31 (51.6)	n/a
Hospital Treatment	34/34 (100)	31/31 (100)	n/a
Correct Diagnosis	3/34 (8.82)	4/31 (12.9)	n/a

Discussion and Conclusions

The results demonstrate that weblogs are a source of stories of heart attack experiences most of which present descriptions of symptoms. The validity of the description of experiences in the weblog stories is suggested by replication of some previous findings in studies based on hospital interview data: the greater

frequency of traditional than non-traditional symptoms, and women patients experiencing higher rates of mortality.

The results also offer some new findings involving variables that modulated symptom reports and sex differences, but that have been relatively unexplored in previous studies. As hypothesized, symptoms for heart attack patients varied according to gender, and in the direction that was predicted. Chest pain and shortness of breath are the two most classically recognized symptoms of heart attack, and the results of this study indicate that men are significantly more likely to experience these symptoms than women. This has implications in terms of public health concerns that women may not be as aware of when they are having a heart attack. This could translate into not seeking appropriate medical care in a timely fashion, and ultimately increased mortality.

Women mortality was significantly higher than for men, yet the small sample size of this study would suggest that further research is needed. Further research is needed to follow up this finding with a study with a greater number of patients that will allow control of variables confounded with sex in the present study.

The results also demonstrate some of the limitations of using weblogs as a source of data. Important information about the patient, especially age, was often not reported. This is part of the fragmentary data problem inherent in this type of research. The stories were from public blogs and written by people who were not given specific instructions on which details to include. The distribution of ages that were included in stories showed over-representation of younger adults

and very few patients older than the age of 65. This is consistent with younger adults using weblogs more than older adults. The age bias in weblog users also contributes to the availability of heart attack stories, suggesting that weblog stories may be especially useful for research on illness that affects young adults. I obtained 65 stories with heart attack experiences including symptoms from an accumulation of 17 million stories over two years. Clearly, the research will be strengthened over successive years and the continuing accumulation of stories.

Conclusions

The method of using weblogs to collect data for medical research has the advantage of being fast and inexpensive relative to interview studies in hospitals. Our results demonstrate that this method can produce interesting new findings that have important implications for understanding sex differences in heart attack experiences. Future research with a larger sample is required to replicate these findings while controlling possibly confounding variables.

Finally, the description of symptoms in blogs is important in terms of testing sex differences, but also for the insight it provides into the nature of heart attack symptoms that are read by people who frequent weblog or search the internet to obtain information about strokes. That is, the internet has become a key destination for people seeking information about disease [29] and thus stories in blogs are likely to influence how people conceptualize heart attack symptoms.

Future Works

Follow up studies on heart attack can be done by adding more stories over time as the corpus of blogs gets larger. If the corpus is expanded, the sample size may be big enough to find significant differences between the sexes. Using this same methodology, our team is aiming to find sex differences in symptoms, management and care of other medical disorders as well.

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Appendix I: Dummy Story

I felt discomfort in my chest that became a sharp pain in my chest. I felt crushing pressure on my chest. I felt a dull ache in my left arm that became stronger and radiated to my chest. I had difficulty breathing and I felt dizzy and had a fainting spell. I called for an ambulance. At the hospital, they diagnosed a heart attack I felt discomfort in my chest that became a sharp pain in my chest. I felt crushing pressure on my chest. I felt a dull ache in my left arm that became stronger and radiated to my chest. I had difficulty breathing and I felt dizzy and had a fainting spell. I called for an ambulance. At the hospital, they diagnosed a heart attack.

Appendix II: Annotation Coding Form
Coding form

Narrative
1. Narrative style: 1st person 3rd person

4. Sex of patient: male female

5. Age of patient: 0-17 18-29 30-44 45-64 65-75 76-84 85 or older

6. Age in years (if available):

Symptoms
7. Symptoms are described: yes no

8. Discomfort, pressure, heaviness, or pain in the chest

9. Discomfort, pressure, heaviness, or pain in the arm, back, jaw, throat or below the breastbone

10. Fullness, indigestion, or choking feeling (may feel like heartburn)

11. Sweating

12. Nausea, vomiting

13. Dizziness

14. Extreme weakness

15. Anxiety, nervousness

16. Shortness of breath

17. Felt like they had the flu

18. Other symptom

Events
19. Called 911: yes no

21. Treatment at scene by EMT or medical personnel: yes no

22. Treatment in hospital or by MD: yes no

23. Delay from symptoms onset to treatment:
0-1 hour 1-2 hours 2-4 hours 4-24 hours 24-48 hours more than 48 hours

24. Diagnosis by MD or hospital was: correct misdiagnosed

25. Outcome: good (recovered) bad (dead, stroke)

History
26. Incidence: first time recurring

27. Family history: yes no

28. Pre-existing conditions (hypertension, etc.): yes no

Appendix III: Notes on Annotation Guidelines

2) Narrator witnessed the event: Yes was marked for cases where a heart attack happens in the presence of another person.

8) Discomfort, pressure, heaviness, or pain in the chest: Marked if there was any mention of pain, or abnormality in terms of a physical feeling such as pressure in the chest region.

10) Fullness, indigestion, or choking feeling (may feel like heartburn): Marked if victim had abnormal or disturbing sensation within the chest cavity.

18) Other symptom: Marked when any symptom other than the ones previously listed was mentioned.

26) Incidence (First time or Recurring): Marked first time unless previous heart attack is explicitly mentioned. This assumption was made because, people are very likely to mention previous heart attack incident when blogging about another one.

27) Patient has a family history of heart attack: Not assumed or marked unless stated explicitly.

28) Patient has pre-existing conditions placing him/her at a higher risk for heart attack : Marked for any condition or habits that increases risk of heart attack. Some of the conditions reported in the blogs were congenital heart defect, hypertension, diabetes, smoking, heavy drinking, high cholesterol, atrial fibrillation, previous heart attack or stroke and previous heart or brain surgery.

32) Treatment given at hospital: In cases of 911 calls, assumed immediate care unless explicitly stated. In other cases, was left blank if not explicitly stated.

33/34/35) Diagnostic tests/Medications/Diagnosis: If treated at hospital, unless abnormalities were explicitly stated, diagnostic tests, medications as well as a correct diagnosis were assumed.

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