Theses and Dissertations   Graduate School

2004

Is Number of Pregnancies a Risk Factor for Heart Attack in Women?

Pavan Kumar Irukulla
Virginia Commonwealth University

Is Number of Pregnancies a Risk Factor for Heart Attack in women?

PAVAN KUMAR IRUKULLA, MBBS

Virginia Commonwealth University
Medical College of Virginia Campus
School of Medicine

DEPARTMENT OF PREVENTIVE MEDICINE AND COMMUNITY HEALTH

Master of Public Health Program

April/2004

DEDICATION

I would like to dedicate this work to my dad, Irukulla Madan Mohan, my mom, Irukulla Madhavi, and my brothers, Irukulla Naveen Kumar and Irukulla Klayan Kumar, for their innumerable patience and constant support.

CONTENTS

LIST OF TABLES

TABLE

LIST OF FIGURES

FIGURES

Acknowledgment

I would like to express gratitude to my advisor Dr. C.M.G. Buttery for his patience and my preceptor Dr. Tilahun Adera for the generous giving of his time and knowledge unselfishly during the preparation of this project. I am grateful for their invaluable assistance while transitioning through this program.

I would also like to thank Dr. Saba Masho for her patience and Lisa Anderson, Ms. Karen Bryant and Rhonda Stanfield for their support through the preparation of this project.

Is Number of Pregnancies a Risk Factor for Heart Attack in Women?

ABSTRACT:

Background: Studies regarding number of pregnancies and coronary heart disease have shown inconsistent results. In the present study, we assessed the association between number of pregnancies and heart attack (HA) in women.

Methods: Using data from NHANES III a cross sectional data analysis of 10634 women aged 17 and above was conducted. We considered socio-demographic factors and other potential risk factors including physical activity, smoking, alcohol, diabetes, hypertension, hypercholesterolemia, BMI, age, and family history of heart attack. We conducted Bivariate analysis to determine prevalence and crude odds ratios. Multivariate logistic regression analysis was used to adjust for confounding variables using SPSS.

Results: The prevalence and 95% CI of HA was 3.4% (3.0% – 3.7%). The age adjusted odds ratios for 7+ pregnancies was 2.33 95% CI [1.42-3.81], but this became insignificant when a fully adjusted model was used (odds ratio, 1.68: 95% CI, 0.89 to 3.16). For those with 4 pregnancies the risk was lowest in both age adjusted and fully adjusted models confirming the well known "J" shaped non linear relationship between number of pregnancies and heart attack.

Conclusion: We found an association that was not significant between number of pregnancies and heart attack. Further studies using physician-confirmed diagnosis is needed to appropriately asses the potential relationship of gravidity and heart attack.

INTRODUCTION

The prevalence of Coronary heart disease (CHD) and Myocardial Infarction or heart attack (MI or HA) in United States are 6.4% and 3.5% respectively [1]. In women the prevalence of Coronary heart disease and Myocardial Infarction are 6.0% and 2.1% [1]. Cardiovascular disease (CVD) continues to be the leading cause of death in women over age 50 in the United States [2, 3, 4, 5]. The world health organization in 1990 reported that heart disease is the leading cause of death for women of all ages in the United States. This disease accounts for nearly 30% of all deaths among women [5]. CVD accounted for 38.5 percent of all deaths or 1 of every 2.6 deaths in the United States in 2001 [1]. CVD mortality was about 60 percent of "total mortality". This means that of over 2,400,000 deaths from all causes, CVD was listed as a primary or contributing cause on about 1,408,000 death certificates [1]. The potential risk factors of Myocardial Infarction are Hypertension [6, 7, 8], Diabetes [5, 8, 9, 10], Physical inactivity [12, 13, 14], Hypercholesterolemia [4, 5, 11], Obesity [10, 15], Family History of MI [15, 16,] and Smoking [11, 17, 18].

Many studies were performed to determine relationship between parity/gravidity and coronary heart disease and these studies were conflicting. About 5 prospective studies [19, 20, 21, 22, 23] were performed in the past of which 4 of them had positive [19, 20, 21, 22] associations between gravidity or parity and Coronary Heart disease. In addition to these studies analysis from Nurses health study compared women in the median parity group (three births) with those in the highest group (five births) and with nulliparous women showed that nulliparous women had insignificant higher coronary heart disease rates than did the median group [24]. A prospective study performed by Gordon et al did not find any relation between parity and CHD [23]. Prospective study performed by Ness et al using

Framingham and NHANES I Epidemiologic Follow-up Study (NHEFS) reported that there was 70% and 90% (after adjusting for age, Systolic blood pressure, smoking history, glucose tolerance, left ventricular hypertrophy, total cholesterol, education and Body Mass Index) increased risk respectively in multigravida women (six or more pregnancies) [20]. Haynes et al found that the subset of Framingham women who were parous and worked outside the home had significantly higher rates of CHD than did parous women or nulliparous women working in the home [22]. A study in Britain found 25% increased risk in married parous women with 5 or more live births than in nulliparous women [19].

Many of the case-control and cross-sectional studies conducted were inconsistent. Some studies found positive [25, 26] associations, some no significant relations [31] and some protective effects [27, 28, 29]. In a large cross-sectional study performed by Beral, found that parous women had lower mortality from breast, ovarian, and endometrial cancer than did nulliparous women but a higher mortality from diabetes mellitus, gallbladder disease, cancer of the uterine cervix, nephritis and nephrosis, hypertension, ischemic and degenerative heart disease, cerebrovascular disease, and all causes of death [25]. A population study performed by Palmer et al found an increased relative risk of CHD in women with 5 or more births and an independently increased risk for those with first birth before age 20 after adjusting for confounding [26].

A cross-sectional study performed by Lawlor et al found a positive association between parity and CHD for those with at least 2 children, and each additional child increased the age-adjusted odds of CHD by 30% (odds ratio, 1.30; 95% confidence interval, 1.17 to 1.44) for women. Adjustment for obesity and metabolic risk factors

attenuated the associations between greater number of children and CHD in both sexes, although in women, some association remains [30]. In both women and men, there were "J" shaped associations between number of children and age-adjusted prevalent CHD, with the prevalence being lowest among those with 2 children [30].

Steenland et al conducted an analysis of 585,445 women from the American Cancer Society Cancer Prevention Survey II (from 1981 to 1989). After controlling for a number of cardiovascular risk factors, they found no increased trend in heart disease with increased parity [31].

The largest case-control and cross-sectional studies showed significant positive association. Conflicting findings among other studies may have resulted because age varied among studies and degree of control for potentially confounding factors varied among studies. Those studies that used women who were aged 60 or less, an age range in which few women develop heart disease therefore these studies could not find an association and studies that found positive association included cases of all ages [32].

In the present study, we the assessed association and strength of the association between number of pregnancies and heart attack after controlling for established risk factors of CHD.

METHODS

Survey

The National Center for Health Statistics (NCHS) of the Centers for Disease Control and Prevention (CDC) collects, analyzes, and disseminates data on the health status of U.S. residents. The National Health and Nutrition Examination Survey (NHANES) is a periodic survey conducted by NCHS. The third National Health and Nutrition Examination Survey (NHANES III) was conducted from 1988 through 1994. About 39,695 persons were selected over the six years; of those, 33,994 (86%) were interviewed in their homes. All interviewed persons were invited to mobile examination center (MEC) for a medical examination. Seventy-eight percent (30,818) of the selected persons were examined in the MEC, and an additional 493 persons were given a special, limited examination in their homes. Participants were interviewed in their homes to determine socio-demographic, medical and family history data. A standardized set of physical examinations and laboratory measurements was performed in a mobile examination center. The overall response rate for completion of the interview and physical examination was 78% in NHANES III. The data set is divided into 5 groups, 1) adults (age$\geq$ 17) 2) youth (age<17) 3) EXAM (physical examination conducted at MEC) 4) Laboratory data and 5) Diet [44].

Participants

Of the 33,994 interviewed subjectes in the NHANES III data set, women aged 17 years or more were selected (N=10,649). For these women, medical examination data were merged from the mobile examination center and the home exam. From this merged

data file of 10,649 females, 15 were excluded because they had heart attack before their last pregnancy resulting in a sample size of 10,634.

Our independent variable was constructed from two survey questions: the first question was "Have you ever been pregnant?" and if they answered "yes" they were asked "How many times were you pregnant?" The outcome variable for this study is heart attack (MI) and participants were asked the following question "Doctor ever told you had a heart attack?" Participants who said "yes" to this question were classified as having a heart attack (MI).

Population characteristics

Pregnancy, BMI and alcohol history were in the exam data files of NHANES III. The rest of the variables demographic, socioeconomic, lifestyle, other risk factors of heart attack and dependent variable (heart attack) were in the adult data files of NHANES III.

Socio-demographic characteristics included age, categorized into <29, 30-39, 40-49, 50-59, 60-69, 70-79 and 80+. The main racial backgrounds identified are non Hispanic white, non Hispanic black, Mexican American and others. Socio-economic status includes, education categorized into <8yrs 'Elementary/Middle school', 9-12 yrs 'High School' and >13yrs 'College & above' and family income per year is categorized into <$20,000, and >20,000 per year. Lifestyle factors included smoking, alcohol and physical activity. Smoking and alcohol was dichotomized into 'Yes' or 'No'. "Jog or run, bicycle, swim, aerobic exercise, dancing, gardening weights and other sports" all these activity variables were combined into Physical activity and dichotomized into 'Yes' or 'No'.

Risk factors of ischemic heart disease such as diabetes, hypertension, hyper cholesterol, obesity (body mass index) and family history of heart attack were also included. Diabetes, hypertension and hyper cholesterol were asked if they were diagnosed previously by a physician. Only if mother or father had history of heart attack were considered in family history of heart attack. Obesity was measured using BMI as <25 normal, 25-29 overweight and >30 obese.

Number of pregnancies was categorized in 4 different ways never been pregnant, 1, 2, 3, 4, 5, 6, and 7+ and never been pregnant, 1-2, 3-4, 5-6 and 7+ pregnancies, <2, 2, 3, 4 & 5+ pregnancies and <2, 2-4 & 5+ pregnancies.

Statistical Methods

The objective of this study was to determine if there was any association between number of pregnancies and heart attack in women age 17 and above and to asses the magnitude of association if there was any. The socio-demographic variables (race, income and educational level) and other potential risk factors such as age, family history of heart attack, body mass index, smoking, alcohol, physical inactivity, diabetes, hypertension, and hypercholesterolemia are used as covariates in our analysis. Epi-info 6 was used to calculate prevalence and the 95% CI. Bivariate regression analysis will be performed on un-weighted data to examine possible associations among the general characteristics of the population. Statistical analysis included for both continuous and categorical variables. Our final Logistic regression Model was based on the significance of both continuous and categorized variables at $p<0.05$. Variables that did not show significance in the bivariate analysis, but were considered to be risk factors in literature, were included. List of

variables included in multivariate logistic regression (models 1-5) are age, race/ethnicity, education, income, exercise, smoking, alcohol, and history of diabetes, hypertension, cholesterol and family history of heart attack. In model 6 fewer variables (income, BMI, HTN, Diabetes, Hypercholesterolemia, family history of heart attack, age) were used to adjust for number of pregnancy. Age adjusted odds ratios for different categories of number of pregnancies were calculated. Various models were assessed by categorizing number of pregnancies in different ways and taking out some of the demographic variable and non-potential risk factors of heart attack to determine an association between number of pregnancies and heart attack if there was any. SPSS 11.5 was used to calculate bivariate and multivariate logistic regression.

RESULTS

The life time prevalence of heart attack was 3.4%. While 71% of the women were pregnant at least once and 14.6% said they were never pregnant. The mean age was 47.6 yrs ranging from 17 – 90 yrs (Table 1).

The distributions of heart attack and non heart attack across different variables are shown in table 1. The majority of the women were 'non-Hispanic white' (43.3%), '≤29' age group (24.6%), 'High School' educated (50.6%), '<$20,000' income (50.9%), 'Normal weight ≤ 24' BMI (34.5%) 'Active' activity (61.7%), 'Yes' Pregnancy (71.0%) and who did not have Hypertension, Diabetes, Cholesterol, Family history of heart attack, never smoked or had alcohol. It was observed that 'non-Hispanic white' had the highest percentage of heart attack (64.1%). The age group '70-79'has the highest percentage of heart attack (33.1%), Income '<$20,000' (72.4%), 'High School' educated (49%), Diabetics (61.9%), Non-Hypertensive (51.6%), Non Hypercholesterolemia (71.7%), BMI ≥30 (38.4%), not Smoked (56.6%), Consumed Alcohol (60.9%), Pregnant at least once (86.3%), 7+ pregnancies (22.4%) among number of pregnancies categorized into 0, 1, 2, 3, 4, 5, 6 & 7+ Pregnancies, 1-2 pregnancies (28.6%) among number of pregnancies categorized into 0, 1-2, 3-4, 5-6 & 7+ Pregnancies, 5+ Pregnancies (38.6%) among number of pregnancies categorized into <2, 2, 3, 4, & 5+ Pregnancies, 5+ Pregnancies (38.6%) among number of pregnancies categorized into <2, 2-4, & 5+ Pregnancies, Inactive (56%), and No Family History of heart attack (78.2%).

Prevalence and 95% Confidence Interval (CI) are shown in table 2. The prevalence of heart attack in this sample was 3.36%. The highest prevalence of heart attack was among Non- Hispanic Whites 4.98 and 95% CI [4.37-5.65]. Among age groups '80+' had highest prevalence 11.63 and 95% CI [9.75-13.81]. Low income '<$20,000' had highest prevalence of 4.66 and 95% CI [4.12-5.26]. Among Educational Levels 'Elementary/Middle School' seem to be having the highest prevalence 5.39 and 95% CI [4.53-6.40]. As expected the prevalence among diabetics, hypertensive & hypercholesterolemics had the highest prevalence than those who did not, 9.92 and 95% CI [8.12-12.04], 7.04 and 95% CI [6.18-8.01] and 6.85 and 95% CI [5.79-8.09] respectively. Groups with BMI 25-29 & ≥30 had highest prevalence of 3.45 and 95% CI [2.83-4.20] & 3.73 and 95% CI [3.10-4.47] respectively. Smokers had highest prevalence of 3.89 and 95% CI [3.32-4.55] but not much different from Non smokers 3.04 and 95% CI [2.65-3.49]. Among 'No' group of alcohol had highest prevalence of 3.57 and 95% CI [2.90-4.37]. Women with no physical activity (Inactive) had the highest prevalence of 4.91 and 95% CI [4.28-5.64]. Prevalence among women who had a family history of heart attack had the highest prevalence 4.52 and 95% CI [3.56-5.72]. The prevalence among pregnant women was 3.1 and 95% CI [2.73-3.52] where as in non pregnant women it was 1.61[1.06-2.36]. When number of pregnancies categorized into 0, 1, 2, 3, 4, 5, 6 & 7+ pregnancies, the prevalence's seem to increase as the number of pregnancies increase and 7+ pregnancies had the highest prevalence of 6.52 and 95% CI [5.03-8.34]. When categorized into <2, 2, 3, 4 & 5+ pregnancies 5+ had the highest prevalence of 4.96 and 95% CI [4.07-6.03] and it was twice the other prevalence.

Multivariate adjusted odds ratio and unadjusted odds ratio for heart attack are shown in table 3. In this table pregnancy is dichotomized into 'Yes' or 'No'. Non-Hispanic whites had no difference in risk when compared with Non-Hispanic Blacks and the other's group had protective effect even after adjusting 0.51 and 95% CI [0.30-0.89]. For Income level lower than $20,000 had higher risk with adjusted OR of 1.42 and 95% CI [1.00-2.02]. Elementary/Middle School was not significant but High School had highest adjusted OR of 1.74 with a significant 95% CI and 95% CI [1.14-2.67]. As age was used as a continuous variable, for increase in one year there is 7% significant increased risk of HA. Diabetes, hypertension and hypercholesterolemia all had significant higher risk than who did not have these diseases even after adjustment confirming previous studies, 2.58 [1.80-3.69], 1.81 [1.31-2.49] & 1.62 [1.2-2.19] respectively. BMI was used as a continuous variable but did not show any significant adjusted ratios though unadjusted showed minimal increase in risk of 1.02[1.01-1.04]. Though the unadjusted OR's showed a higher risk for smoking and physical inactivity and protective effect for alcohol use there was no significant risk when adjusted for all the other variables in the table. Family history of heart attack showed a significant risk for heart attack when adjusted for all other variables with OR of 1.85 and 95% CI of [1.25-2.72]. The women who were pregnant had 16% higher risk than those who were never pregnant, but this was not statistically significant 1.16 and 95% CI [0.69-1.96].

Various models were analyzed that are shown in table 4 with their multivariate adjusted odds ratio and unadjusted odds ratio. In model 1 (Fig: 1) number of pregnancies is categorized into 0, 1, 2, 3, 4, 5, 6 & 7+ pregnancies, model 2 (Fig: 2) they are categorized into 0, 1-2, 3-4, 5-6 & 7+ pregnancies. Where as in model 3 & 4 never been

pregnant and women with one pregnancy were combined and used as a reference population, in model 3 (Fig: 3) number of pregnancies is categorized into <2, 2, 3, 4 & 5+ pregnancies and in model 4 (Fig: 4) they are categorized into <2, 2-4 & 5+ pregnancies. In model 5 pregnancy status is dichotomized in to 'Yes' or 'No'. In all these models the highest unadjusted OR's with significant 95% confidence intervals were in those women who had highest number of pregnancies that is 5+ or 7+ pregnancies. In model 6 (Fig: 5) number of pregnancies were categorized similar to model 2 but model 6 was not adjusted for education, race, smoking, alcohol use and physical activity and was adjusted only for income, diabetes, HTN, Hypercholesterolemia, BMI, Family history of heart attack and age. Though we adjusted only for important risk factors there was no significant association between number of pregnancies and heart attack. In all the models the risk was attenuated when fully adjusted but both the adjusted and unadjusted OR are in the same direction that is increasing risk with increasing number of pregnancies after 4th pregnancy. We also observed in all the models the 'J' shaped curve confirming previous studies. The 'J' curve is due to decrease in risk initially till 4th pregnancy and then starts to rise again after 4th pregnancy.

Multivariate adjusted odds ratio and unadjusted odds ratio are represented in graphical form with number of pregnancies on x-axis and odds ratios on y-axis (Fig: 1, 2, 3, 4 & 5). When fully adjusted multivariate adjusted odds ratio was attenuated when compared with unadjusted odds ratio but there was a trend of increasing risk with increasing number of pregnancies after 4th pregnancy in both multivariate adjusted odds ratio and unadjusted odds ratio. The lowest risk was observed for 4th pregnancy and thus

confirming the "J" shaped curve from previous studies. In all these models the findings were similar the only difference was categorization of number of pregnancies.

For comparison age adjusted odds ratio and multivariate adjusted odds ratio for heart attack are shown in table 5. In both Model 1 & 2 age adjusted OR had significant risk for 7+ pregnancies of 2.33 and 95% CI [1.42-3.81] and in model 3 & 4 5+ pregnancies had highest age adjusted OR 1.58 and 95% CI [1.12-2.21]. In Model 5 where pregnancy is dichotomized into 'Yes' or 'No' and the risk for pregnant women was higher than women who were never pregnant when only age was adjusted but this was not significant, odds ratio 1.52 and 95% CI [0.99-2.34].

DISCUSSION

The greater the number of pregnancies the stronger the association with heart attacks, but this was not significant. Age adjusted odds ratio for 7+ pregnancies were significantly associated with heart attack, but became insignificant when it was fully adjusted to all other risk factors. The 2 studies performed by Ness et al using Framingham data and National Epidemiologic Follow-up Study (NHEFS) data found an association with between 6+ pregnancies and CHD [20]. Because these studies were prospective studies this cross-sectional approach to the study may be the reason for lack of a significant association. This study considered family history of heart attack, alcohol history and physical activity where as the study performed by Ness et al did not consider these factors. This study only considered myocardial infarction as the end point or out come variable but Ness et al study took angina pectoris, unrecognized myocardial infarction and coronary death or sudden death along with myocardial infarction. This study could not consider angina pectoris because the question asked was not reliable "did you ever have chest discomfort?" or "did you ever have chest pain?" Discomfort and chest pain could be due to various chest pathology or gastrointestinal pathology.

Lawlor et al found that number of children was inversely associated with high-density lipoprotein cholesterol and was positively associated with triglycerides and diabetes [30]. This study states that the risk was lowest among those with 2 children and increasing linearly with each additional child beyond 2 and for those with at least 2 children, each additional child increased the age-adjusted odds of CHD by 30% (odds ratio, 1.30; 95% confidence interval, 1.17 to 1.44) for women [30]. The study design used

by Lawlor et al was a cross-sectional study design but the data was obtained from a prospective data collection.

A population study performed by Beral concluded that parous women had lower mortality from breast, ovarian, and endometrial cancer than did nulliparous women but a higher mortality from diabetes mellitus, gallbladder disease, cancer of the uterine cervix, nephritis and nephrosis, hypertension, ischemic and degenerative heart disease, cerebrovascular disease, and all causes of death [25]. Though the study found a lower mortality from cancers in parous women it also found a higher mortality from other chronic disease like ischemic heart disease, diabetes and hypertension.

Prospective study performed by Colditz found an inverse relationship between parity and coronary heart disease. The discrepancy of this study is dues to its small sample size and short range of age in the population [24].

A case-control study performed by Beard et al found a relative risk of 1.9 for women whose age at first pregnancy was less than 20 and 1.8 for those whose age at first pregnancy was 20-24, as compared with those never pregnant [33]. Another hospital based case-control study performed by La Vecchia did not show any clear trend in risk with the number of live births, miscarriages, or induced abortions but showed an association in women whose first pregnancy or live birth occurred before age 20 years when compared with non pregnant women [34]. Since we did not consider age of first pregnancy in our study we cannot compare our study with these studies.

The largest case-control and cross-sectional studies showed significant positive association. Conflicting findings among other studies may have resulted because age varied among studies and degree of control for potentially confounding factors varied

14

among studies. Those studies that used women who were aged 60 or less, an age range in which few women develop heart disease therefore these studies could not find an association and studies that found positive association included cases of all ages [32]. Though our sample was large and we included all women age 17 and above the associations in this study were found not significant.

Though our study found not statistically significant association, other studies found an association. The explanations for the association are as follows (Figure 6). 1) Number of pregnancy may be associated with HA possibly because of elevation glucose levels [35] and lipid levels [36, 37, 38]. 2) Pregnancy causes physiologic anemia [39], nocturnal hypoventilation [40] and circulatory overload [41, 42], these could cause increased stress on heart and repeated stress in successive pregnancies can lead to increased risk of HA. 3) The hemodynamic changes and increase in progesterone levels of pregnancy appear to be the cause of arterial alterations which may lead to aneurysm formation [42, 43]. Aneurysms in coronary increase the risk of plaque formation and thus increase the risk for myocardial infarction.

Conclusion

This study determined the association between number of pregnancies and heart attack that was not significant. In our study 7+ pregnancies had insignificantly higher risk than those who were never pregnant. Further studies using physician-confirmed diagnosis is needed to appropriately assess the potential relationship of gravidity and heart attack.

TABLES

Table 1. Distribution of Heart Attack for women in NHANES III N=10,634

Variable	Total		Heart Attack		No Heart Attack	
	N	%	N	%	N	%
Race						
Non Hispanic White	4602	43.3	229	64.1	4343	42.9
Non Hispanic Black	2977	28.0	81	22.7	2854	28.2
Others	3055	28.7	47	13.2	2921	28.9
Income						
< $20,000	5408	50.9	252	72.4	5058	51.3
>20,000	4948	46.5	96	27.6	4794	48.7
Blank but applicable	172	1.6				
Don't know	106	1.0				
Education Level						
Elementary/Middle	2355	22.1	127	35.8	2186	21.8
High School	5385	50.6	174	49.0	5134	51.2
College	2788	26.2	54	15.2	2701	27.0
Blank but applicable	69	0.6				
Don't know	37	0.3				
Age						
≤29yrs	2620	24.6	1	0.3	2569	25.4
30-39yrs	1972	18.5	4	1.1	1941	19.2
40-49yrs	1466	13.8	10	2.8	1432	14.2
50-59yrs	1104	10.4	36	10.1	1047	10.3
60-69yrs	1307	12.3	71	19.9	1219	12.0
70-79yrs	1159	10.9	118	33.1	1028	10.2
80+yrs	1006	9.5	117	32.8	882	8.7
Diabetes						
Yes	948	8.9	94	26.3	838	8.3
No	9669	90.9	263	73.7	9265	91.6
Blank but applicable	3		0		1	
Don't know	14	0.1			14	0.1
Hypertension						
Yes	3139	29.5	221	61.9	2880	28.6
No	7433	69.9	135	37.8	7178	71.2
Blank but applicable	1				3	
Don't know	18	0.2	1	0.3	17	0.2
Hyper Cholesterol						
Yes	1941	18.3	133	48.4	1797	33.7
No	3705	34.8	142	51.6	3524	66.0
Blank but applicable	3				1	
Don't know	17	0.2			17	0.3

Table 1. Distribution of Heart Attack for women in NHANES III N=10,634   (cont...)

Variable	Total N	Total %	Heart Attack N	Heart Attack %	No Heart Attack N	No Heart Attack %
BMI (Kg/M²)						
<=24	3664	34.5	80	27.2	3532	38.4
25-29	2925	27.5	101	34.4	2780	30.2
>= 30	3029	28.5	113	38.4	2880	31.3
Blank but applicable	42	0.4	6	2.0	33	0.4
Smoking						
Yes	3980	37.4	155	43.4	3771	37.3
No	6645	32.5	202	56.6	6340	62.7
Blank but applicable	9	0.1			7	0.1
Alcohol						
Yes	6503	61.2	165	60.9	6260	69.7
No	2607	24.5	93	34.3	2470	27.7
Blank but applicable	272	2.6	13	4.8	248	2.8
Don't know	1				1	
Physical Activity						
Inactive	4067	38.2	200	56.0	3815	37.7
Active	6556	61.7	157	44.0	6294	62.3
Fanily History of Heart Attack						
Yes	1527	14.4	69	19.3	1431	14.1
No	8879	83.5	279	78.2	8469	83.7
Blank but applicable	3		1	0.3	2	
Don't know	225	2.1	8	2.2	215	2.1
Pregnancy						
Yes	7550	71.0	234	86.3	7215	80.4
No	1557	14.6	25	9.2	1511	16.8
Blank but applicable	273	2.6	12	4.4	250	2.8
Don't know	2				2	
Number of pregnancies						
0	1557	14.6	25	9.7	1511	17.3
1	1258	11.8	35	13.5	1211	13.9
2	1726	16.2	39	15.1	1664	19.1
3	1510	14.2	37	14.3	1448	16.6
4	1039	9.8	23	8.9	1002	11.5
5	704	6.6	29	11.2	668	7.7
6	421	4.0	13	5.0	401	4.6
7+	890	8.4	58	22.4	819	9.4

Table 1. Distribution of Heart Attack for women in NHANES III N=10,634 (cont...)

Variable	Total N	Total %	Heart Attack N	Heart Attack %	No Heart Attack N	No Heart Attack %
Number of pregnancies						
0	1557	28.1	25	9.7	1511	17.3
1 - 2	2984	24.0	74	28.6	2875	33.0
3 - 4	2549	10.6	60	23.2	2450	28.1
5 - 6	1125	8.4	42	16.2	1069	12.3
7+	890	14.6	58	22.4	819	9.4
Number of pregnancies						
<2	2815	26.5	60	23.2	2722	31.2
2	1726	16.2	39	15.1	1664	19.1
3	1510	14.2	37	14.3	1448	16.6
4	1039	9.8	23	8.9	1002	11.5
5+	2015	18.9	100	38.6	1888	21.6
Number of pregnancies						
<2	2815	26.5	60	23.2	2722	31.2
2-4	4275	40.2	99	38.2	4114	47.2
5+	2015	18.9	100	38.6	1888	21.6

19

Table 2. Prevalence & 95% CI of Heart attack in Women of NHANES III

Variable	Total N	Heart Attack N	Prevalence (%)	95% CI
Total	10,634	357	3.36	[3.03-3.72]
Race				
Non Hispanic White	4602	229	4.98	[4.37-5.65]
Non Hispanic Black	2977	81	2.72	[2.18-3.39]
Others	3055	47	1.54	[1.14-2.06]
Income				
< $20,000	5408	252	4.66	[4.12-5.26]
>20,000	4948	96	1.94	[1.58-2.37]
Education Level				
Elementary/Middle School	2355	127	5.39	[4.53-6.40]
High School	5385	174	3.23	[2.78-3.75]
College	2788	54	1.94	[1.47-2.54]
Age				
<29yrs	2620	1	0.04	
30-39yrs	1972	4	0.2	[0.07-0.56]
40-49yrs	1466	10	0.68	[0.35-1.30]
50-59yrs	1104	36	3.26	[2.33-4.53]
60-69yrs	1307	71	5.43	[4.29-6.84]
70-79yrs	1159	118	10.18	[8.53-12.10]
80+yrs	1006	117	11.63	[9.75-13.81]
Diabetes				
Yes	948	94	9.92	[8.12-12.04]
No	9669	263	2.72	[2.41-3.07]
Hypertension				
Yes	3139	221	7.04	[6.18-8.01]
No	7433	135	1.82	[1.53-2.15]
Hyper Cholesterol				
Yes	1941	133	6.85	[5.79-8.09]
No	3705	142	3.83	[3.25-4.51]
BMI				
<=24	3664	80	2.18	[1.75-2.72]
25-29	2925	101	3.45	[2.83-4.20]
>= 30	3029	113	3.73	[3.10-4.47]
Smoking				
Yes	3980	155	3.89	[3.32-4.55]
No	6645	202	3.04	[2.65-3.49]
Alcohol				
Yes	6503	165	2.54	[2.18-2.96]
No	2607	93	3.57	[2.90-4.37]

Table 2. Prevalence & 95% CI of Heart attack in Women of NHANES III   (cont...)

Variable	Total N	Heart Attack N	Prevalence (%)	95% CI
Physical Activity				
Inactive	4067	200	4.91	[4.28-5.64]
Active	6556	157	2.39	[2.04-2.80]
Fanily History of Heart Attack				
Yes	1527	69	4.52	[3.56-5.72]
No	8879	279	3.14	[2.79-3.53]
Pregnancy				
Yes	7550	234	3.1	[2.73-3.52]
No	1557	25	1.61	[1.06-2.36]
Number of pregnancies				
0	1557	25	1.61	[1.06-2.36]
1	1258	35	2.78	[1.97-3.89]
2	1726	39	2.26	[1.63-3.11]
3	1510	37	2.45	[1.75-3.40]
4	1039	23	2.21	[1.44-3.36]
5	704	29	4.11	[2.82-5.93]
6	421	13	3.09	[1.73-5.36]
7+	890	58	6.52	[5.03-8.34]
Number of pregnancies				
0	1557	25	1.61	[1.06-2.36]
1 - 2	2984	74	2.48	[1.97-3.12]
3 - 4	2549	60	2.35	[1.82-3.04]
5 - 6	1125	42	3.73	[2.74-5.06]
7+	890	58	6.52	[5.03-8.34]
Number of pregnancies				
<2	2815	60	2.13	[1.64-2.75]
2	1726	39	2.26	[1.63-3.10]
3	1510	37	2.45	[1.75-3.40]
4	1039	23	2.21	[1.44-3.36]
5+	2015	100	4.96	[4.07-6.03]
Number of pregnancies				
<2	2815	60	2.13	[1.64-2.75]
2-4	4275	99	2.32	[1.90-2.82]
5+	2015	100	4.96	[4.07-6.03]

21

Table 3. UnAdj & Multivariate Adj odds Ratios for Heart Attack

Variable	Total N	UnAdj OR	95% CI	Total N	Multivariate Adj OR	95% CI
Race						
Non Hispanic White	4572	1.86	[1.44-2.40]	2334	0.91	[0.61-1.37]
Non Hispanic Black	2935	1		1234	1	
Others	2968	0.57	[0.39-0.82]	983	0.51	[0.30-0.89]
Income						
< $20,000	5310	2.49	[1.96-3.16]	2030	1.42	[1.00-2.02]
>20,000	4890	1		2521	1	
Education Level						
Elementary/Middle	2313	2.91	[2.10-4.02]	835	1.37	[0.83-2.29]
High School	5308	1.70	[1.25-2.31]	2189	1.74	[1.14-2.67]
College	2755	1		1527	1	
Age	10475	1.07	[1.06-1.08]	4551	1.07	[1.05-1.08]
Diabetes						
Yes	932	3.95	[3.09-5.05]	476	2.58	[1.80-3.69]
No	9528	1		4075	1	
Hypertension						
Yes	3101	4.08	[3.28-5.08]	1596	1.81	[1.31-2.49]
No	7313	1		2955	1	
Hyper Cholesterol						
Yes	1930	1.84	[1.44-2.34]	1579	1.62	[1.2-2.19]
No	3666	1		2972	1	
BMI	9486	1.02	[1.01-1.04]	4551	1.00	[1.00-1.00]
Smoking						
Yes	3926	1.29	[1.04-1.60]	1744	1.35	[0.97-1.88]
No	6542	1		2807	1	
Alcohol						
Yes	6425	0.70	[0.54-0.91]	3397	0.96	[0.68-1.36]
No	2563	1		1154	1	
Physical Activity						
Active	4015	2.10	[1.70-2.60]	1522	0.99	[0.72-1.37]
Inactive	6451	1		3029	1	
Fanily History of Heart Attack						
Yes	1500	1.46	[1.12-1.92]	725	1.85	[1.25-2.72]
No	8748	1		3826	1	
Pregnancy						
Yes	7449	1.96	[1.29-2.97]	3915	1.16	[0.69-1.96]
No	1536	1		636	1	

‡ Each variable in the multivariate model is adjusted all other variables in the table.

Table 4. Various models showing Adj ‡ & UnAdj Odd's Ratios for Heart Attack

Model	Pregnancies	N	UnAdj OR	95% CI	Multi Variate OR	95% CI	N
1	0	1536	1		1		636
	1	1246	1.75	[1.04-2.94]	1.25	[0.66-2.38]	593
	2	1703	1.42	[0.85-2.35]	0.96	[0.51-1.78]	903
	3	1485	1.54	[0.93-2.58]	1.06	[0.56-2.01]	793
	4	1025	1.39	[0.78-2.46]	0.87	[0.44-1.72]	567
	5	697	2.62	[1.53-4.51]	1.37	[0.70-2.66]	388
	6	414	1.96	[0.99-3.86]	1.37	[0.62-3.03]	209
	7+	877	4.28	[2.66-6.89]	1.68	[0.89-3.16]	462
2	0	1536	1		1		636
	1-2	2949	1.56	[0.98-2.46]	1.08	[0.61-1.90]	1496
	3-4	2510	1.48	[0.92-2.37]	0.97	[0.54-1.74]	1360
	5-6	111	2.38	[1.44-3.92]	1.37	[0.74-2.54]	597
	7+	877	4.28	[2.66-6.89]	1.67	[0.89-3.15]	462
3	<2	2782	1		1		1229
	2	1703	1.06	[0.71-1.60]	0.84	[0.52-1.38]	903
	3	1485	1.16	[0.77-1.76]	0.94	[0.56-1.56]	793
	4	1025	1.04	[0.64-1.69]	0.77	[0.44-1.35]	567
	5+	1988	2.40	[1.74-3.33]	1.32	[0.87-2.00]	1059
4	<2	2782	1		1		1229
	2-4	4213	1.09	[0.79-1.51]	0.85	[0.57-1.26]	2263
	5+	1988	2.40	[1.74-3.33]	1.32	[0.87-2.00]	1059
5	Y	7449	1.96	[1.29-2.97]	1.16	[0.69-1.96]	3915
	N	1536	1		1		636
*6	0	1536	1		1		638
	1-2	2949	1.56	[0.98-2.46]	1.14	[0.65-2.00]	1500
	3-4	2510	1.48	[0.92-2.37]	1.04	[0.58-1.85]	1362
	5-6	111	2.38	[1.44-3.92]	1.36	[0.74-2.50]	603
	7+	877	4.28	[2.66-6.89]	1.45	[0.79-2.68]	465

‡ Adjusted for income, education, race, activity, smoking, alcohol BMI, HTN, diabetes, hypercholesterol, family history of heart attack, age.

*Adjusted for income, BMI, HTN, diabetes, hypercholesterolemia, family history of heart attack, age.

23

**Table 5. Multivariate Adj OR ‡ & AgeAdj Odd's Ratios for Heart Attack**

Model	Pregnancies	Age Adj OR	95% CI	N	Multivariate Adj OR	95% CI	N
1	0	1		1536	1		636
	1	1.57	[0.92-2.70]	1243	1.25	[0.66-2.38]	593
	2	1.19	[0.71-2.01]	1703	0.96	[0.51-1.78]	903
	3	1.35	[0.79-2.28]	1485	1.06	[0.56-2.01]	793
	4	1.07	[0.59-1.92]	1025	0.87	[0.44-1.72]	567
	5	1.88	[1.07-3.30]	697	1.37	[0.70-2.66]	388
	6	1.36	[0.68-2.72]	414	1.37	[0.62-3.03]	209
	7+	2.33	[1.42-3.81]	877	1.68	[0.89-3.16]	462
2	0	1		1536	1		636
	1-2	1.35	[0.84-2.16]	2949	1.08	[0.61-1.90]	1496
	3-4	1.22	[0.75-1.99]	2510	0.97	[0.54-1.74]	1360
	5-6	1.68	[1.00-2.82]	111	1.37	[0.74-2.54]	597
	7+	2.33	[1.42-3.81]	877	1.67	[0.89-3.15]	462
3	<2	1		2782	1		1229
	2	0.94	[0.61-1.43]	1703	0.84	[0.52-1.38]	903
	3	1.06	[0.69-1.63]	1485	0.94	[0.56-1.56]	793
	4	0.84	[0.51-1.39]	1025	0.77	[0.44-1.35]	567
	5+	1.58	[1.12-2.21]	1988	1.32	[0.87-2.00]	1059
4	<2	1		2782	1		1229
	2-4	0.95	[0.68-1.33]	4213	0.85	[0.57-1.26]	2263
	5+	1.58	[1.12-2.21]	1988	1.32	[0.87-2.00]	1059
5	Y	1.52	[0.99-2.34]	7449	1.16	[0.69-1.96]	3915
	N	1		1536	1		636
*6	0	1		1536	1		638
	1-2	1.35	[0.84-2.16]	2949	1.14	[0.65-2.00]	1500
	3-4	1.22	[0.75-1.99]	2510	1.04	[0.58-1.85]	1362
	5-6	1.68	[1.00-2.82]	111	1.36	[0.74-2.50]	603
	7+	2.33	[1.42-3.81]	877	1.45	[0.79-2.68]	465

‡ Adjusted for income, education, race, activity, smoking, alcohol BMI, HTN, diabetes, hypercholesterol, family history of heart attack, age.

*Adjusted for income, BMI, HTN, Diabetes, Hypercholesterolemia, Family History of Heart Attack, age.
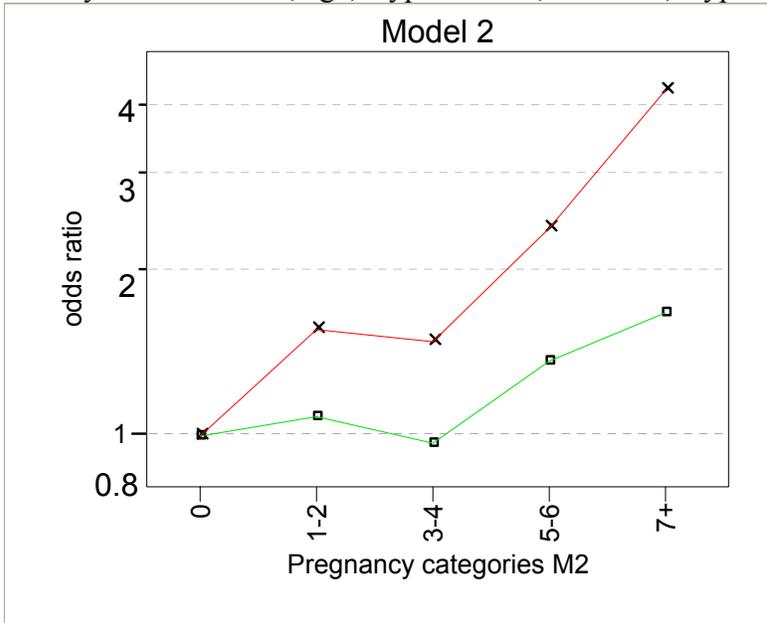
24

FIGURES

Figure 1. Adjusted for income, education, race, Activity, smoking, alcohol BMI, Family History of heart attack, age, Hypertension, Diabetes, Hyper cholesterol.
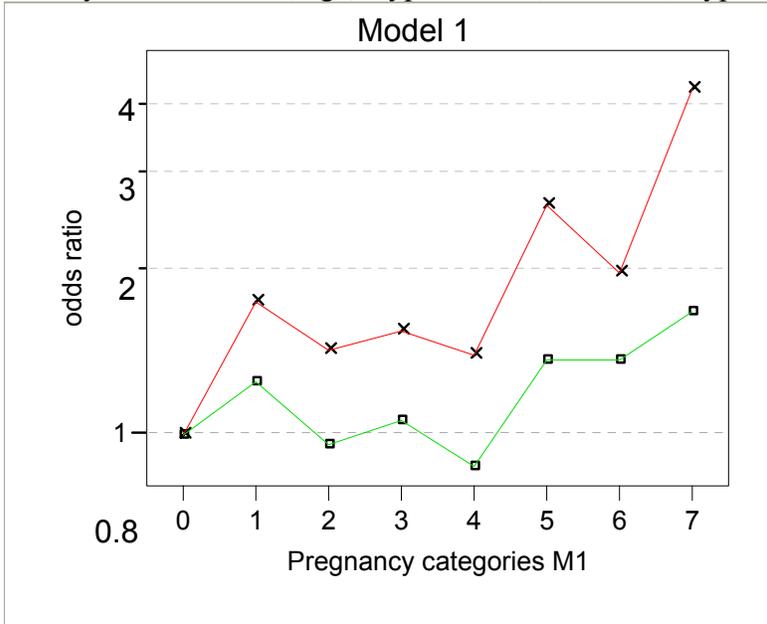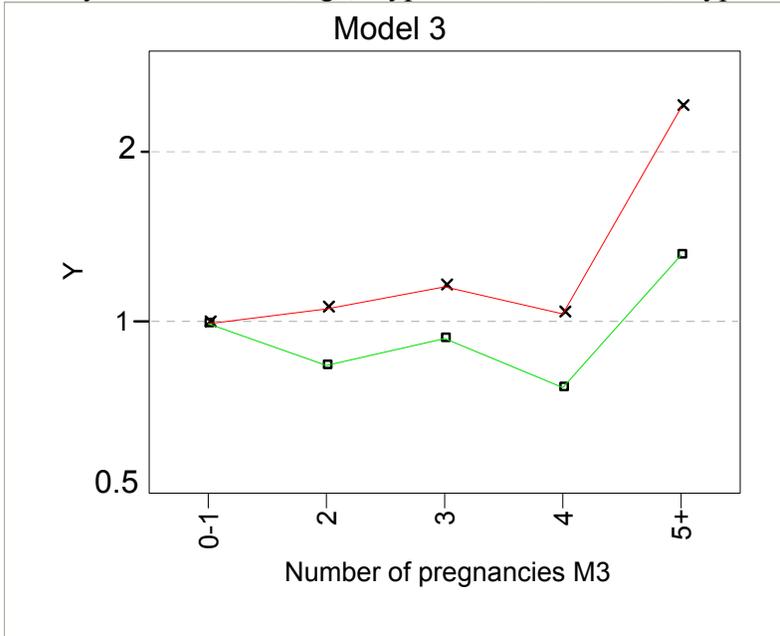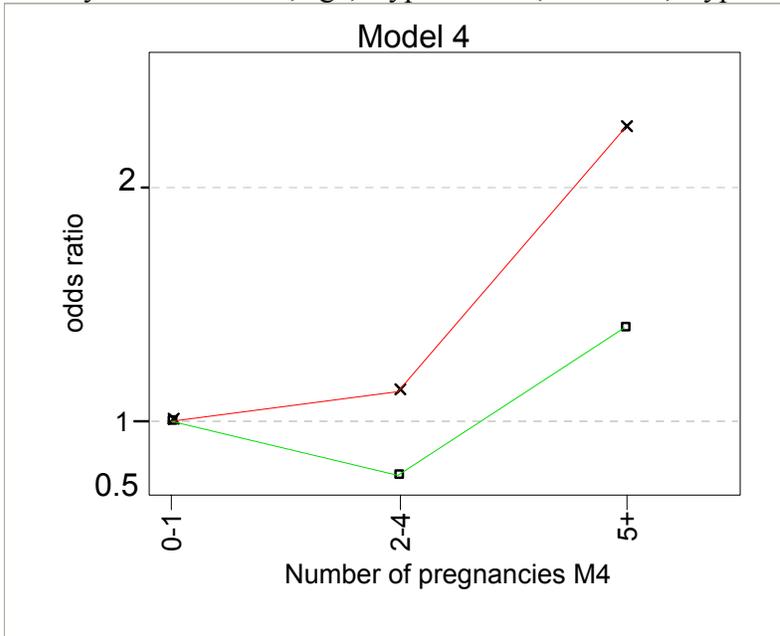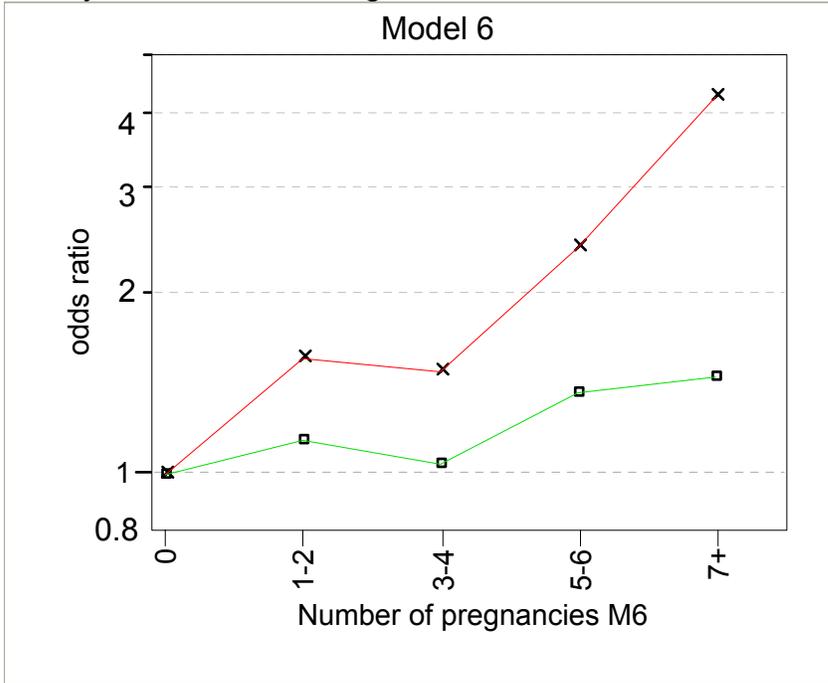

Y ✕— UnAdj OR   ◻— Multi Variate OR

Figure 2. Adjusted for income, education, race, Activity, smoking, alcohol BMI, Family History of heart attack, age, Hypertension, Diabetes, Hyper cholesterol.
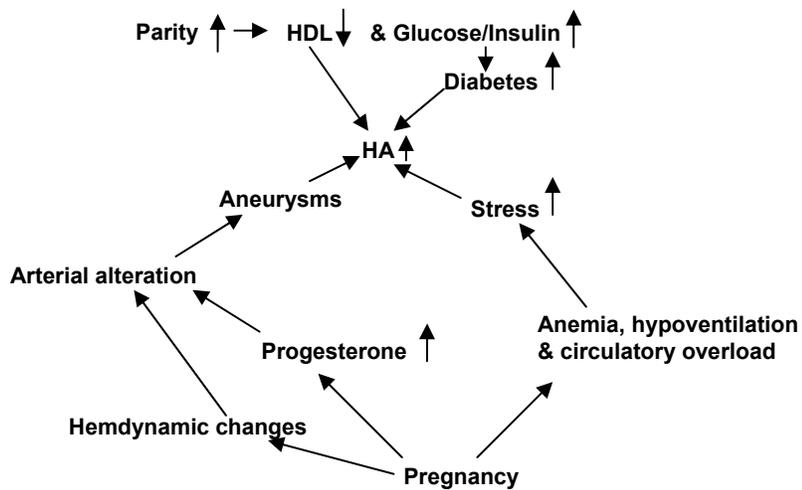

Y ✕— UnAdj OR   ◻— Multi Variate OR

Figure 3. Adjusted for income, education, race, Activity, smoking, alcohol BMI, Family History of heart attack, age, Hypertension, Diabetes, Hyper cholesterol.

Figure 4. Adjusted for income, education, race, Activity, smoking, alcohol BMI, Family History of heart attack, age, Hypertension, Diabetes, Hyper cholesterol.

Figure 5. Adjusted for income, BMI, Hypertension, Diabetes, Hyper cholesterol, Family History of heart attack and age.

Figure 6. How does pregnancy increase risk of HA?

REFERENCE

1   http://www.americanheart.org/downloadable/heart/1079736729696HDSStats2004
    UpdateREV3-19-04.pdf

2   Tecce MA, Dasgupta I, Doherty JU. Heart disease in older women. Gender
    differences affect diagnosis and treatment. Geriatrics. 2003 Dec;58(12):33-9; quiz
    40.

3   Grodstein F, Stampfer M.   The epidemiology of coronary heart disease and
    estrogen replacement in postmenopausal women. Prog Cardiovasc Dis. 1995
    Nov-Dec;38(3):199-210.

4   O'Brien T; Nguyen T.T. Lipids and lipoproteins in women. Mayo Clin Proc. 1997
    Mar;72(3):235-44.

5   Sowers JR. Diabetes Mellitus and Cardiovascular Disease in Women. Arch Intern
    Med. 1998 Mar 23;158(6):617-21.

6   Asmar R. Benefits of blood pressure reduction in elderly patients. J Hypertens.
    2003 Jul; 21 Suppl 6:S25-30.

7   Gerdts E, Omvik P, Mo R, Kjeldsen SE. Hypertension and heart disease Tidsskr
    Nor Laegeforen. 2004 Mar 18; 124(6):802-5.

8   La Vecchia C, Franceschi S, Decarli A, Pampallona S, Tognoni G. Risk factors
    for myocardial infarction in young women. Am J Epidemiol. 1987 May;
    125(5):832-43.

9   Zammit Maempel JV. Diabetes as a coronary risk factor in Malta. Isr J Med Sci.
    1978 Apr;14(4):418-23.

10 Jensen G, Nyboe J, Appleyard M, Schnohr P. Risk factors for acute myocardial
    infarction in Copenhagen, II: Smoking, alcohol intake, physical activity, obesity,

oral contraception, diabetes, lipids, and blood pressure. Eur Heart J. 1991 Mar;12(3):298-308.

11 Gramenzi A, Gentile A, Fasoli M, D'Avanzo B, Negri E, Parazzini F, La Vecchia C. Cigarette smoking and the risk of myocardial infarction. A case-controlled study in northern Italy G Ital Cardiol. 1989 Jan;19(1):82-8.

12 Frank CW, Weinblatt E, Shapiro S, Sager RV. Physical inactivity as a lethal factor in myocardial infarction among men. Circulation. 1966 Dec;34(6):1022-33.

13 Hardman AE. Exercise in the prevention of atherosclerotic, metabolic and hypertensive diseases: a review. J Sports Sci. 1996 Jun;14(3):201-18.

14 Bigert C, Gustavsson P, Hallqvist J, Hogstedt C, Lewne M, Plato N, Reuterwall C, Scheele P. Myocardial infarction among professional drivers. Epidemiology. 2003 May;14(3):333-9.

15 Leon AS. Age and other predictors of coronary heart disease. Med Sci Sports Exerc. 1987 Apr;19(2):159-67.

16 Lewandowski K, Kwasnikowski P, Elikowski W, Zawilska K. Myocardial infarction in patients aged less than 40 years. Frequency of BclI polymorphism in the fibrinogen beta-chain gene and plasma fibrinogen. Kardiol Pol. 2003 Sep;59(9):205-12.

17 Wilson K, Gibson N, Willan A, Cook D. Effect of Smoking Cessation on Mortality After Myocardial Infarction Meta-analysis of Cohort Studies. Arch Intern Med. 2000 Apr 10;160(7):939-44.

18 Nancy A. Rigotti; Kathleen M. McKool, Saul Shiffman. Predictors of Smoking Cessation after Coronary Artery Bypass Graft Surgery Results of a Randomized Trial with 5-Year Follow-up. Ann Intern Med. 1994 Feb 15;120(4):287-93.

19 Green A, Beral V, Moser K. Mortality in women in relation to their childbearing history. *BMJ*. 1988;297:391–395.

20 Ness RB, Harris T, Cobb J, et al. Number of pregnancies and the subsequent risk of cardiovascular disease. *N Engl J Med*. 1993;328:1528–1533.

21 Dekker JM, Schouten EG. Number of pregnancies and risk of cardiovascular disease. *N Engl J Med*. 1993;329:1893–1894.

22 Haynes SG, Feinleib M. Women, work and coronary heart disease: prospective findings from the Framingham heart study. Am J Public Health. 1980 Feb;70(2):133-41.

23 Gordon T, Kannel WB, Hjortland MC, McNamara PM. Menopause and coronary heart disease. The Framingham Study. Ann Intern Med. 1978 Aug;89(2):157-61.

24 Colditz GA, Willett WC, Stampfer MJ, Rosner B, Speizer FE, Hennekens CH. A prospective study of age at menarche, parity, age at first birth, and coronary heart disease in women. Am J Epidemiol. 1987 Nov;126(5):861-70.

25 Beral V. Long term effects of childbearing on health. J Epidemiol Community Health. 1985 Dec;39(4):343-6.

26 Palmer JR, Rosenberg L, Shapiro S. Reproductive factors and risk of myocardial infarction. Am J Epidemiol. 1992 Aug 15;136(4):408-16.

27 Talbott E, Kuller LH, Detre K, Perper J. Biologic and psychosocial risk factors of sudden death from coronary disease in white women. Am J Cardiol. 1977 May 26; 39(6):858-64.

28 Talbott E, Kuller LH, Perper J, Murphy PA. Sudden unexpected death in women: biologic and psychosocial origins. Am J Epidemiol. 1981 Nov;114(5):671-82.

29 Talbott EO, Kuller LH, Detre K, Matthews K, Norman S, Kelsey SF, Belle S. Reproductive history of women dying of sudden cardiac death: a case-control study. Int J Epidemiol. 1989 Sep; 18(3):589-94.

30 Lawlor DA, Emberson JR, Ebrahim S, Whincup PH, Wannamethee SG, Walker M, Smith GD. Is the association between parity and coronary heart disease due to biological effects of pregnancy or adverse lifestyle risk factors associated with child-rearing? Findings from the British Women's Heart and Health Study and the British Regional Heart Study. Circulation. 2003 Mar 11;107(9):1260-4.

31 Steenland K, Lally C, Thun M. Parity and coronary heart disease among women in the American Cancer Society CPS II population. Epidemiology. 1996 Nov;7(6):641-3.

32 Ness RB, Schotland HM, Flegal KM, et al. Reproductive history and coronary heart disease risk in women. Epidemiol Rev. 1994; 16:298–314.

33 Beard CM, Fuster V, Annegers JF. Reproductive history in women with coronary heart disease. A case-control study. Am J Epidemiol. 1984 Jul; 120(1):108-14.

34 La Vecchia C, Decarli A, Franceschi S, Gentile A, Negri E, Parazzini F. Menstrual and reproductive factors and the risk of myocardial infarction in

women under fifty-five years of age. Am J Obstet Gynecol. 1987 Nov;157(5):1108-12.

35 Hollingsworth DR. Alterations of maternal metabolism in normal and diabetic pregnancies: differences in insulin-dependent, non-insulin-dependent, and gestational diabetes. Am J Obstet Gynecol 1983;146:417-429.

36 de Alvarez RR, Gaiser DF, Simkins DM, Smith EK, Bratvold GE. Serial studies of serum lipids in normal human pregnancy. Am J Obstet Gynecol 1959;77:743-757.

37 Potter JM, Nestel PJ. The hyperlipidemia of pregnancy in normal and complicated pregnancies. Am J Obstet Gynecol 1979;133:165-170.

38 Fahraeus L, Larsson-Cohn U, Wallentin L. Plasma lipoproteins including high density lipoprotein subfractions during normal pregnancy. Obstet Gynecol 1985;66:468-472.

39 Bashiri A, Burstein E, Sheiner E, Mazor M. Anemia during pregnancy and treatment with intravenous iron: review of the literature. Eur J Obstet Gynecol Reprod Biol. 2003 Sep 10;110(1):2-7.

40 Trakada G, Tsapanos V, Spiropoulos K. Normal pregnancy and oxygenation during sleep. Eur J Obstet Gynecol Reprod Biol. 2003 Aug 15;109(2):128-32.

41 Mesa A, Jessurun C, Hernandez A, Adam K, Brown D, Vaughn WK, Wilansky S. Left ventricular diastolic function in normal human pregnancy. Circulation. 1999 Feb 2;99(4):511-7.

42 Selo-Ojeme DO, Welch CC. Review: Spontaneous rupture of splenic artery aneurysm in pregnancy. Eur J Obstet Gynecol Reprod Biol. 2003 Aug 15;109(2):124-7.

43 Barrett JM, Van Hooydonk JE, Boehm FH. Pregnancy-related rupture of arterial aneurysms. Obstet Gynecol Surv. 1982 Sep;37(9):557-66.

44 http://www.cdc.gov/nchs/data/nhanes/nhanes3/ADULT-acc.pdf