Maternal Pre-Pregnancy Body Mass Index and Maternal Morbidity in the United States:
New data from the Birth Certificate, 2015

By
Iman M. Saleh

A paper presented to the faculty of The University of North Carolina at Chapel Hill in
partial fulfillment of the requirements for the degree of Master of Public Health in the
Department of Maternal and Child Health. Chapel Hill, N.C.

March 14, 2018

Approved by:

Tamar Engel-Kulka MD, MPH
First Reader

Jon M. Hussey
Second Reader
Abstract

Objective: To investigate the effect of maternal pre-pregnancy body mass index on maternal morbidity in the United States.

Methods: Maternal pre-pregnancy body mass index was categorized as follow: underweight (<18.5), normal (18.5-24.9), overweight (25.0-29.9), and obesity (≥30). The odds ratio (OR) and 95% CIs of maternal morbidity by pre-pregnancy BMI were estimated by multivariable adjusted logistic regression models.

Results: There were 355 cases of maternal morbidity. Compared with obese women, the adjusted ORs (95%CIs) for maternal morbidity in underweight, normal, and overweight women were 0.47 (0.21- 1.08), 1.00 (0.78-1.30), 0.81(0.60-1.08) respectively.

Conclusion: Obese women had the highest maternal morbidity.
Table of Contents

I. Introduction.................................................................................................................. 3
II. Methods......................................................................................................................11
III. Results....................................................................................................................14
IV. Discussion...............................................................................................................19
V. Conclusion...............................................................................................................20
VI. References..............................................................................................................21
VII. Acknowledgements....................................................................................................
1- Introduction

The target of Millennium Developmental Goal 5 was to achieve 75% reduction in maternal mortality between 1990 and 2015. Maternal mortality ratio is one of the main indicators of maternal health status in any given country. The target of the Sustainable Developmental Goals is to reduce the global maternal mortality ratio to less than 70 per 100,000 live births between 2016 and 2030. While the ratio of maternal mortality to acute maternal morbidity is 1:20 it is 1:30 for chronic maternal morbidity. Maternal morbidity is a complex area with a wide spectrum of severity and presentation. Recently the World Health Organization (WHO) defined Maternal morbidity as “any health condition attributed to and/or aggravated by pregnancy and childbirth that has a negative impact on the woman’s wellbeing”. Finding an accurate identification of maternal morbidity in a reliable consistent way is challenging, and still, very little information is known about maternal morbidity.

Maternal mortality and morbidity in the United States of America:

Maternal mortality and morbidity remains a challenge in the United States. Between 1990 and 2013, the maternal mortality ratio for the USA increased from 12 to 28 maternal deaths per 100,000 births. About half of all maternal deaths in the USA are preventable. Three factors may be contributing to the increase in maternal mortality and morbidity in the USA. First, inconsistent obstetric practices (variations in
treatment); hospitals lack the standard management of obstetric emergencies and the early detection of pregnancy and childbirth complications. Nationally supported strategies to manage obstetric emergencies and updated training and guidance on implementing these strategies is an important need. Second, the increasing number of women who seek antenatal care with preexisting chronic conditions, such as hypertension, diabetes and obesity, which increase pregnancy-related complications. Many of these women could benefit from the closer coordination of antenatal and primary care. Third, lack of high quality data and related analysis on maternal health outcomes. Only 50% of the states have maternal mortality review boards and the data that are collected are not systematically used to guide changes that could decrease maternal mortality and morbidity.

Recent research has shown that increased prevalence of obesity and hypertension both before and during pregnancy is associated with severe maternal morbidity. This study will focus on the incidence of any of the four maternal morbidities reported on the birth certificate: maternal transfusion, ruptured uterus, unplanned hysterectomy, and ICU admission. The rates are compared among the different classes of maternal BMI to study the effect of overweight and obesity on maternal morbidity. Obese women may enter pregnancy with existing conditions such as hypertension, thus increasing the likelihood of pregnancy related morbidity and mortality. Pregnancy associated hypertension is another clinical factor that contributed to the trend of rising maternal morbidity. Another contributing factor for the increased maternal morbidity is the increase in the number of births to older women, who tend to have more health problems than younger women. Reducing racial and ethnic disparities in maternal
health should be a priority to decrease maternal morbidity as maternal morbidity is more pronounced in racial and ethnic minorities in the United States. This study will focus on one of the three major factors thought to be driving the increase in maternal morbidity and mortality in the US—maternal obesity. Obesity during pregnancy is an important cause for maternal morbidity. It is associated with an increase in maternal morbidity and a tenfold increase in the prevalence of hypertension. The rising epidemic of obesity has gained global attention as a major public health problem. In general, Obesity is a main risk factor for chronic diseases such as hypertension and cardiovascular disease.

![Trends in pregnancy-related mortality in the United States: 1987–2013](image)

*Note: Number of pregnancy-related deaths per 100,000 live births per year.*

This study is a retrospective secondary data analysis of the data collected from the January 1st - December 31st 2015 United States Natality Public Use File Documentation. Our main aim was to investigate the effect of maternal prepregnancy body mass index (BMI) on the maternal morbidity and the effects of maternal prepregnancy body mass index (BMI) and having a diagnosis of pregnancy-associated hypertension on maternal morbidity. Specifically, we seek to compare maternal morbidity (MM) among women with different body mass index (BMI) classes. We hypothesized that maternal body mass index (BMI) classes are predictive of maternal morbidity. Also, maternal body mass index (BM) classes and a diagnosis of pregnancy-associated hypertension are predictive of maternal morbidity.
Conceptual Model: Our Independent variable (Exposure) is maternal pre-pregnancy body mass index (BMI), defined as weight in kilograms divided by height in meters squared. Body mass index (BMI) < 18.5 kg/m² (group 1; underweight), 18.5 to 24.9 (group 2; normal), 25.0 to 29.9 (group 3; overweight), 30.0 to ≥ 40.0 (group 4; obese). The dependent variable (Outcome) is a composite of maternal morbidity consisting of maternal transfusion, ruptured uterus, unplanned hysterectomy, and admission to intensive care unit. Our mediator is having a diagnosis of Pregnancy-Associated Hypertension. We hypothesized that Pregnancy-Associated Hypertension is influenced by our independent variable and, in turn, affects our dependent variable. This is also called an indirect effect of the independent variable on the dependent variable. Our moderator is the number of prenatal visits, a variable that changes the effect of the independent variable on the dependent variable. Our confounders are maternal age and race. We hypothesized that increased body mass index (BMI) classes are associated with increased maternal morbidity. This relation is affected by maternal age, race, number of prenatal visits, and having a diagnosis of Pregnancy-Associated Hypertension.
**BMI and Maternal Morbidity**: In 2011-2014, more than 36% of adults in the United States were obese\(^1\), which is higher than the Healthy People 2020 goal of 30.5%.\(^1\) The prevalence of obesity was higher among women (38.3%) compared with men (34.3%), and among non-Hispanic white, non-Hispanic black and Hispanic adults compared with non- Hispanic Asian.\(^1\)One retrospective cohort study revealed that as the BMI increases, women tend to have more prenatal visits, be older, have higher incidence of pregnancy related hypertension, and interestingly associated with longer surgical times and wound infections after hysterectomy.\(^1\)Although the focus of this study was to examine the effect of BMI on the peripartum hysterectomies as they excluded scheduled hysterectomies, it came short in terms of how generalizable the results are to the general population as their sample population came from their institutes patients only.
Another study with the focus to understand the causes of pregnancy related death in Virginia found higher maternal mortality ratio among women within the obese BMI class.\textsuperscript{13} Although this study confirms the association of obese BMI class with maternal mortality, the results were significant for the state of Virginia only with no evidence if we can generalize the results nationwide. The focus of the study was mainly the maternal mortality not morbidity.

\textit{Pregnancy related Hypertension and Maternal Morbidity:}

Approximately 17\% of maternal mortality in the United States is due to hypertensive disorders of pregnancy.\textsuperscript{14} Pregnancy associated hypertension is defined as: the incidence of new-onset hypertension after 20 weeks of gestation, in the absence of accompanying proteinuria.\textsuperscript{15}

Hypertensive disorder of pregnancy is the most common causes of admission of pregnant/postpartum women to intensive care.\textsuperscript{16} One retrospective study based on all obstetric admission to ICN at specific hospital in France found that hypertensive disorders of pregnancy particularly preeclampsia is responsible for 26.7\% of the indications for intensive care admissions.\textsuperscript{17} Another study which is retrospective case-control study based on obstetric admissions to the ICU at a hospital in London, UK revealed that, Hypertensive disorders was the main indications for Intensive care admission (39.4\%) followed by obstetric hemorrhage (36.4\%).\textsuperscript{18} A systematic review indications of intensive care admission for women who are either pregnant or up to 6 weeks postpartum found that hypertensive disorders of pregnancy were the most prevalent indication for ICU admission.\textsuperscript{19}
**Age and Maternal Morbidity:**

One retrospective cohort study found that one of the risk factors for maternal morbidity is advanced maternal age. A case-control study based on a rural maternity clinic in Haiti found that older maternal age at delivery (OR = 3.18; 95%CI: 1.31, 7.76) and higher maternal weight (OR = 3.24; 95%CI: 1.76, 5.98) were significantly associated with pregnancy related hypertensive disorders. Interestingly, Prenatal care was not significantly associated with a reduction in the risk for hypertensive disorder of pregnancy.

Another study based on clinical data collected from 39 hospitals in China, revealed that the risk of pregnancy-induced hypertension increases gradually with maternal age greater than 35 years old and the risks of preeclampsia and eclampsia increase in teenage pregnancy.

**Race and maternal morbidity:**

Racial and ethnic disparities persist in maternal morbidity, with non-Hispanic black women having the highest rates among other race groups. The pregnancy-related mortality ratios 2011-2013 were 12.1 death per 100,000 live births for white women, 40.4 deaths per 100,000 live births for black women, and 16.4 deaths per 100,000 live births for women of other races.

One study used data collected from the National Health and Nutrition Examination Survey found that, non-Hispanic blacks have the highest age-adjusted rates of obesity (48.1%) followed by Hispanics (42.5%), non-Hispanic whites (34.5%), and non-Hispanic Asians (11.7%).
A retrospective cohort study in California found that the risk factors for Hypertensive disorder of pregnancy are being Black (OR 1.46 [1.19-1.80]) and Hispanic race (OR 1.56 [1.35-1.79]), maternal age ≤ 20 (OR 1.85 [1.61-2.11]), and <5 prenatal care visits (1.74 [1.46-2.07]).

**Number of prenatal visits and Maternal morbidity:**
Recently the World Health Organization increased the recommended number of prenatal visits from four to eight. Evidences have shown that increasing the number of antenatal contacts by women and adolescent girls with their healthcare provider is associated with a reduction in both maternal and child adverse outcomes. Increase the number of contact will increase the opportunities to early detect and manage possible problems.

**2- Methods**

The Data are from the 2015 United States Natality Public Use File Documentation obtained from the birth certificates. We are using a random sample that represent 2% of all births registered in the 50 states, the District of Columbia, and New York City. The sample is generalizable to the entire United States in 2015. The participants of this population- based observational study were 79,775 women. After complete case analysis, it decreased to 74,059 births (Table 1A).

Table 1A: Participants Pre-Pregnancy Body Mass Index, 74,059, The United States Birth Certificates, 2015
The vital statistics system captures data from all filled birth certificates, it is less likely to experience sampling and nonresponse biases than smaller samples, either probabilistic or non-probabilistic. Still, it is possible, that a small subset of births might not be captured in the data set, such as women who gave birth at home. Our exposure is the maternal pre-pregnancy body mass index, it was categorized as follow: underweight (<18.5), normal (18.5-24.9), overweight (25.0-29.9), and obese (≥30) (table 1B).

Table 1B: Participant characteristic by Pre-Pregnancy Body Mass Index, 74,059 Births, The United States Birth Certificates, 2015
Our outcome is maternal morbidity; a composite of maternal transfusion, ruptured uterus, unplanned hysterectomy, and admission to intensive care unit. Maternal morbidity is coded as a binary variable where “Yes” refers to the presence of maternal morbidity and “No” refers to the absence of maternal morbidity (Table 2).

Table 2: Maternal Morbidity by Pre-Pregnancy Body Mass Index, 74,059 Births, The United States birth certificates, 2015

<table>
<thead>
<tr>
<th>Maternal Pre-Pregnancy Body Mass Index</th>
<th>N= 74,059</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N/%</td>
</tr>
<tr>
<td>Maternal Age</td>
<td></td>
</tr>
<tr>
<td>&lt;20</td>
<td>348 (13%)</td>
</tr>
<tr>
<td>20-24</td>
<td>2,034 (76.3%)</td>
</tr>
<tr>
<td>35 and above</td>
<td>285 (10.7%)</td>
</tr>
<tr>
<td>Maternal Race</td>
<td></td>
</tr>
<tr>
<td>NHW</td>
<td>1,390 (52.1%)</td>
</tr>
<tr>
<td>NHB</td>
<td>341 (12.8%)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>458 (17.1%)</td>
</tr>
<tr>
<td>Other</td>
<td>478 (18%)</td>
</tr>
<tr>
<td>Number of prenatal visits</td>
<td></td>
</tr>
<tr>
<td>0-7 visit</td>
<td>464 (17.4%)</td>
</tr>
<tr>
<td>8-15 visit</td>
<td>1,988 (74.5%)</td>
</tr>
<tr>
<td>16-70 visit</td>
<td>215 (8%)</td>
</tr>
<tr>
<td>Pregnancy-Associated Hypertension</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>2,604 (97.6%)</td>
</tr>
<tr>
<td>Yes</td>
<td>63 (2.4%)</td>
</tr>
</tbody>
</table>

Participants demographics and comorbidities include age, race, and pregnancy associated hypertension; we coded age as follow: less than 20 years (group1), 20-34 years (group 2), and ≥35 (group3). Race was coded as: Non-Hispanic White (group 1), Non-Hispanic Black (group2), Hispanic (group3), and other (group4). Maternal Age and
race were included as potential confounders, age and race are associated with both BMI and maternal morbidity and are not in the causal pathway between BMI and maternal morbidity. Pregnancy associated hypertension was coded as Yes and No where “Yes” refers to having a diagnosis of pregnancy associated hypertension. Pregnancy associated hypertension is a potential mediator in the causal pathway between BMI and maternal morbidity. The number of prenatal care visits was the moderator. We coded the number of prenatal visits as follow: 0-7 visits (group1), 8-15 visits (group2), and 16-70 visits (group3). All statistical tests were formed using STATA (StataCorp. 2017. *Stata Statistical Software: Release 15*. College Station, TX: StataCorp LLC). We first created three distinct logistic regression models. The first, unadjusted model, explored the individual effect of each of the components of our conceptual model [Figure 2] on the maternal morbidity. The second model was adjusted to control for maternal age, race, BMI. The third adjusted model built on model two to include the role of pregnancy associated hypertension and number of prenatal care visits. To explore the moderator [number of prenatal visits] effect, we stratified the final model by number of prenatal visits. To examine the mediator effect [pregnancy associated hypertension] we explored the effect of pre-pregnancy BMI on maternal morbidity first with and then without the mediator.

The point estimates of an association between the independent factors and the outcome were expressed as odd ratios (OR) and described along with their 95% confidence intervals (CI). All reported P-Values were two -tailed and those <0.05 were considered statistically significant.

3- Results
The study population included 74,059 participants. The Participants' base line characteristics are shown in Table 1A and 1B. Table 1A shows that 45.1% of the women had normal BMI while 26% were overweight and 25.3% were obese. Obese women tended to be Non-Hispanic white (49%), 20-24 years old (79.5%), had 8-15 prenatal visits (75.5%), and 9.8% diagnosed with Pregnancy associated hypertension. Of the 74,059 participants, 355 had maternal morbidity (Table 2). Maternal morbidity was the highest among obese women (0.57%), followed by normal weight (0.49%), then overweight (0.42%), and finally underweight (0.22%).

Table 3: Unadjusted and adjusted Odds Ratios for Maternal Morbidity By Independent Variables, 74,059 births, The United States Birth Certificates 2015

<table>
<thead>
<tr>
<th>Unadjusted and Adjusted Odds Ratios for Maternal Morbidity by Independent Variables</th>
<th>Unadjusted OR</th>
<th>95%CI</th>
<th>P-value</th>
<th>Adjusted OR</th>
<th>95%CI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maternal Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;20</td>
<td>1.4</td>
<td>(0.9-2.1)</td>
<td>0.127</td>
<td>1.3</td>
<td>(0.8-1.9)</td>
<td>0.255</td>
</tr>
<tr>
<td>20-24</td>
<td>1.1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>35 and above</td>
<td>1.8</td>
<td>(1.4-2.3)</td>
<td>0</td>
<td>1.8</td>
<td>(1.4-2.3)</td>
<td>0</td>
</tr>
<tr>
<td><strong>Maternal Race</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NHW</td>
<td>0.6</td>
<td>(0.5-0.8)</td>
<td>0</td>
<td>0.6</td>
<td>(0.5-0.8)</td>
<td>0.002</td>
</tr>
<tr>
<td>NHB</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>HISP</td>
<td>0.7</td>
<td>(0.5-1.0)</td>
<td>0.045</td>
<td>0.8</td>
<td>(0.7-1.1)</td>
<td>0.11</td>
</tr>
<tr>
<td>Other</td>
<td>0.7</td>
<td>(0.5-1.0)</td>
<td>0.072</td>
<td>0.7</td>
<td>(0.5-1.1)</td>
<td>0.088</td>
</tr>
<tr>
<td><strong>Number of prenatal visits</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-7 visit</td>
<td>1.8</td>
<td>(1.4-2.3)</td>
<td>0</td>
<td>1.7</td>
<td>(1.3-2.2)</td>
<td>0</td>
</tr>
<tr>
<td>8-15 visit</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>16-70 visit</td>
<td>1.4</td>
<td>(1.0-2.0)</td>
<td>0.048</td>
<td>1.3</td>
<td>(0.9-1.8)</td>
<td>0.122</td>
</tr>
<tr>
<td><strong>Pregnancy-Associated Hypertension</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.1</td>
<td>(2.4-4.2)</td>
<td>0</td>
<td>3</td>
<td>(2.3-4.0)</td>
<td>0</td>
</tr>
<tr>
<td><strong>Maternal Body Mass Index</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweig</td>
<td>0.4</td>
<td>(0.2-0.9)</td>
<td>0.028</td>
<td>0.5</td>
<td>(0.2-1.1)</td>
<td>0.076</td>
</tr>
<tr>
<td>Normal</td>
<td>0.9</td>
<td>(0.7-1.1)</td>
<td>0.219</td>
<td>1</td>
<td>(0.8-1.3)</td>
<td>0.948</td>
</tr>
<tr>
<td>Overweig</td>
<td>0.7</td>
<td>(0.6-1.0)</td>
<td>0.043</td>
<td>0.8</td>
<td>(0.6-1.1)</td>
<td>0.155</td>
</tr>
<tr>
<td>Obese</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Model 1

Overall, the unadjusted model showed significant risk of maternal morbidity based on maternal pre-pregnancy body mass index; this model found that women with BMI ≥30 [obese] were more likely to experience maternal morbidity when compared to other BMI classes. In the unadjusted model, the odds of maternal morbidity for obese women was 2.5 times the odds of maternal morbidity in underweight women. In other words underweight women were 60% less likely to experience maternal morbidity compared to obese women while overweight women were 26% less likely compared to obese women, and women within the normal BMI class were 14% less likely to experience maternal morbidity compared to obese women (Table 3).

The maternal age and maternal morbidity, women 35 years and above was at the highest risk for maternal morbidity.

The association between race/ethnicity and maternal morbidity was not a surprise, given the well-established racial disparity in maternal morbidity, Non–Hispanic black women had the highest maternal morbidity when compared to other races.

The number of prenatal care visits showed a J-shaped curve effect on maternal morbidity, where women with 8-15 prenatal visits were at the lowest risk for maternal morbidity.

Pregnancy-Associated Hypertension is significantly associated with maternal morbidity, where women with pregnancy–associated hypertension showed greater risk for maternal morbidity than those without pregnancy–associated hypertension.

Model 2
After adjusting for maternal age and race, we found that there was still a significant association between BMI and maternal morbidity. The odds of maternal morbidity among obese women remained 2.5 times the odds of maternal morbidity among women with underweight BMI class. Underweight women [OR: 0.4 (0.2-1.0)] were 60% less likely to experience maternal morbidity compared to their obese counterparts.

Women who are 35 years old and above were [OR: 1.9 (1.5-2.4)] 90% more likely to experience maternal morbidity than women who are 20-24 years old.

Non-Hispanic whites were [OR: 0.6 (0.5-0.8)] 40% less likely to experience maternal morbidity than Non-Hispanic Black while Hispanics were [OR: 0.7 (0.5-1.0)] 30% less likely compared to Non-Hispanic Black.

**Model 3**

Model 3 was adjusting for maternal age, race, and pregnancy associated hypertension. We found that women who are 35 years old and above were [OR: 1.8 (1.4-2.3)] 80% more likely to experience maternal morbidity than women who are 20-24 years old.

Non-Hispanic whites were [OR: 0.6 (0.5-0.8)] 40% less likely to experience maternal morbidity than Non-Hispanic Black. Underweight women [OR: 0.5 (0.2-1.1)] were 50% and overweight women [OR: 0.8 (0.6-1.1)] were 20% less likely to experience maternal morbidity compared to obese women. The odds of maternal morbidity are the same in both normal weight women [OR: 1.0 (0.8-1.3)] and obese women. Women with pregnancy associated hypertension are two times the women without pregnancy associated hypertension to experience maternal morbidity. Women with prenatal care
visits less than 8 [OR: 1.6 (1.3-2.2)] are 60% more likely to experience maternal morbidity than women with 8-15 visits.

Mediator Effect:

Consistent with partial mediation, adjusting for pregnancy associated hypertension decreased the odds of maternal morbidity by 10% among all the classes of pre-pregnancy body mass index (Table 4).

Table 4: Mediator Effect

<table>
<thead>
<tr>
<th></th>
<th>Mediator Effect [Pregnancy associated hypertension]</th>
<th>Mediator</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>95%CI</td>
</tr>
<tr>
<td>BMI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td>0.4</td>
<td>(0.2-0.9)</td>
</tr>
<tr>
<td>Normal</td>
<td>0.9</td>
<td>(0.7-1.1)</td>
</tr>
<tr>
<td>Overweight</td>
<td>0.7</td>
<td>(0.6-1.0)</td>
</tr>
</tbody>
</table>

Moderator Effect:

Having 8-15 prenatal visits is a protective factor against maternal morbidity among women of all different body mass index classes, women 35 years old and above, and women with pregnancy associated hypertension (Table 5).

Table 5: Moderator Effect
**4- Discussion:**

This study is one of the first to examine the association between pre-pregnancy BMI and maternal morbidity for all births in the United States using birth certificates. It is less subject to bias such as sampling and non-response. Its findings are generalizable to the whole United States. The study has limitations. First, despite the large study size, there was insufficient statistical power to examine the association between pre-pregnancy BMI and maternal morbidity that required the formation of composite morbidity. Second, Medical and health information were underreported on the birth certificates.

Although maternal morbidity is a rare condition, it is a crucial maternal health problem. The majority of the studies are based on data driven at the institutional or state level. It is difficult to examine maternal morbidity at a national level. Studies that evaluate the validity of the birth certificate data are needed. This study recommends working on
creating a single and precise definition of maternal morbidity then incorporate the required date into the birth certificates.

5- Conclusion:

For many reasons Maternal morbidity is still challenging. Maternal morbidity has a broad spectrum of presentation and severity and its definition could vary by different authors. It was hard to find literature focusing mainly on maternal morbidity without discussing maternal mortality.

Most of the studies about maternal morbidity were based on data from the local institutes and hospitals which could consider a barrier against generalizing their results nationwide. On our literature review, we did not find studies based on data representing the general population of the United States. Our study is one of the first to examine this association for all births in the United States. We recommend working on finding a clear definition for maternal morbidity and reporting maternal morbidity from all over the hospitals within the United States to one entity.
6- References:

*MDG 5: Improve maternal health, World Health Organization, Available at: http://www.who.int/topics/millennium_development_goals/maternal_health/en/


12-Wortman, Alison, Jennifer Hernandez, Denisse Holcomb, karen Wilson, Donald McIntire, Jeanne Sheffield. The effect of BMI on maternal morbidity following emergent peripartum hysterectomy. American Journal of Obstetrics & Gynecology, Volume 210, Issue 1, S292 - S293


24-World Health Organization, Pregnant women must be able to access the right care at the right time, says WHO, 2016. Available at: http://www.who.int/mediacentre/news/releases/2016/antenatal-care-guidelines/en/