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Investigating the Aetiology of Placental Pathology and its Relationship with Preeclampsia

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ABSTRACT

Placenta Previa poses significant perinatal risks for pregnant women globally, and despite its prevalence, its epidemiological characteristics remain not fully understood, a preliminary study was conducted in Benghazi, including Benghazi Medical Center, and Derna. The research aimed to investigate the causes leading to placenta Previa and gather insights into its epidemiological characteristics. Data collected from January 1, 2022, to December 30, 2022, revealed 60 cases (0.05% of pregnant women) in Benghazi and 15 cases (0.43%) in Derna. The study focused on identifying causes before and during pregnancy, and postpartum information was collected to assess the health status of both mothers and infants. While providing initial insights, this preliminary investigation highlights the need for further research to inform preventive measures and interventions for placenta Previa.

1. INTRODUCTION

The placenta develops when the fetus establishes a firm attachment to the lining of the uterus. It originates from the blastocyst during a phase when it consists of two clearly differentiated embryonic cell types: the outer trophoblast cells and the inner cell mass, comprised of 32-64 fetal cells (Gupta et al., 2002). The outer layer of the pre-implantation embryo, referred to as the trophectoderm (TE), and the inner cell mass (ICM) form five days post-fertilization. They become closely connected to the maternal circulation to support their growth and development. The placenta consists of 50% cells from the mother and 50% cells from the baby, and it can reach up to one-third of the baby's weight.

Initially, the placenta is in a relatively low-oxygen environment, but as it grows, it provides oxygen to the fetus (Brett et al., 2014). Placental villi are covered by cells called cytotrophoblasts and syncytiotrophoblasts, each possessing distinct characteristics (Carter, 2011). Dr. Fisher's research laboratory primarily concentrates on trophoblasts. Their findings reveal that when trophoblasts infiltrate blood vessels, specific proteins on their surfaces, known as adhesion molecules, undergo alterations to enhance their mobility. It has been suggested that a mutation in mitochondrial DNA could be linked to the onset of type 2 diabetes in newborns (Fisher et al., 2021). Trophoblasts undergo additional transformations as well, adopting characteristics that mimic the cells of the blood vessels they infiltrate, as observed in the work of Fisher et al. (1989). Once again, Fisher et al. scrutinized crucial facets of mitochondrial function in placentas from both healthy pregnancies and those complicated by gestational diabetes mellitus (GDM). Their examination encompassed both whole tissue and isolated mitochondria, revealing mitochondrial dysfunction in placental trophoblast cells in cases where mothers experienced GDM. Interestingly, in the spiral arteries that supply the uterine lining, trophoblasts replace the mother's own cells. This phenomenon mirrors what researchers observed in cancer cells during metastasis, as they move away from the primary tumor to invade other parts of the body (Red-Horse et al., 2004). The placenta reaches full formation between 18 to 20 weeks of pregnancy but continues to undergo growth throughout the entire gestational period. Tracy Bale's research has uncovered that not all placentas develop uniformly, with the placenta of a male fetus being more susceptible to external stress compared to that of a female fetus. This vulnerability may potentially impact the embryo. Despite male fetuses generally being larger than females throughout gestation, they also exhibit higher rates of spontaneous abortions, stillbirth, premature birth, and neurodevelopmental conditions (Holtan and Creedon, 2009). Even after delivery, placental tissue contains both fetal and maternal cells. The developmental timeline of the placenta illustrates its changes over the course of pregnancy, with a maximum lifespan of about 40 weeks (Gupta et al., 2002). Within this relatively brief span, the placenta plays a crucial role in promoting the well-being of both the growing embryo and the mother. It serves as an immune barrier that safeguards both the mother and the fetus (Graham et al., 2015). Furthermore, the baby's stem cells can traverse the placenta to aid in the healing of its mother's organs, including the brain, liver, kidney, and lungs (Dawe et al., 2007). The placenta also generates cells that contribute to protecting the mother's heart and preventing breast cancer. While cancer during pregnancy is a rare occurrence – a survey indicated that approximately 1 in every 1,000 pregnant women is diagnosed with some form of cancer – experts anticipate an increase in the number of pregnant women with cancer due to the trend of women delaying childbirth until later in life, which raises the risk of cancer development (Costanzo et al., 2018). The placenta, a truly remarkable organ, exhibits its uniqueness during a normal pregnancy. Specialized cells, known as cytotrophoblasts, undergo differentiation into various specialized subpopulations that play a pivotal role in governing fetal growth and development. A subset of cytotrophoblasts acquires tumor-like properties, enabling them to invade the decidua and myometrium. This same subset also adopts a vascular phenotype, allowing these fetal cells to breach and subsequently line uterine blood vessels. In pregnancies complicated by hypertension, cytotrophoblast invasion tends to be shallow, and vascular transformation remains incomplete (Fisher, 2004). The multinucleated syncytiotrophoblast (STB) of the placenta is a unique tissue in the human body.

It forms the epithelial covering of the fetal villous tree facing the maternal blood and performs vital functions for a successful pregnancy, including active transport, immunologic defense, and synthesis of peptide and steroid hormones (Heazell et al., 2006). Generated from the underlying population of mononuclear cytotrophoblast cells (CTB), the STB undergoes proliferation, differentiation, and ultimately fusion with the syncytiotrophoblast (Heazell et al., 2006). The nuclear appearances of STB vary with gestational age, and towards term, many nuclei exhibit dense aggregates of heterochromatin, often clustered in groups referred to as syncytial knots (Heazell et al., 2006).
These STB nuclei are released into the maternal circulation after 2-3 weeks through apoptotic mechanisms (Huppertz et al., 2006), the primary objective of this research, conducted in Benghazi (Benghazi Medical Center) and selected outpatient clinics in Derna, was to discern the prevalence of infection among cases, contrasting them with uninfected ones. The study sought to not only quantify the percentage of infected cases but also to categorize the type of infection, determine the timing of infection, identify causative factors, assess the associated risks, and conduct post-childbirth follow-ups for infected cases to ascertain the health status of both the mother and the fetus.

2. METHOD

The research methodology employed in this study aimed to systematically collect and analyze data related to pregnant patients in Benghazi Medical Center and two clinics in Derna. The study period spanned from January 1, 2022, to December 30, 2022. The following steps outline the scientific workflow:

1. **Study Population Selection:**
    - Identified and included all pregnant patients who sought care at Benghazi Medical Center and the selected clinics in Derna during the specified time frame.
2. **Census and Categorization:**
    - Conducted a comprehensive census of the pregnant patient population.
    - Categorized patients into two groups based on their health condition—normal and abnormal (diagnosed with placenta praevia).
3. **Quantitative Analysis:**
    - Quantified the number of pregnant women in each group at Benghazi Medical Center and the clinics in Derna.
- Analyzed demographic details, emphasizing age distribution within the affected groups.
4. **Structured Questionnaire Development:**
    - Developed a structured questionnaire to collect detailed information from affected women.
5. **Questionnaire Administration:**
    - Administered the questionnaire to the identified patients, focusing on key aspects such as:
        - Age of the patients.
        - Month in which the infection occurred.
        - Causes of placental abruption.
        - Postpartum information, including type and timing of birth.
        - Health status of the mother and fetus.

3. RESULT

Through a field survey in the cities of Benghazi and Derna, data were collected for (60) women from the city of Benghazi out of 13,150 pregnancies, as well as data for (15) women from the city of Derna out of 3,440. This data collection spanned from January 1, 2022, to December 30, 2022 (Fig. 1a.b), with participants' ages ranging between 17 and 40 years.

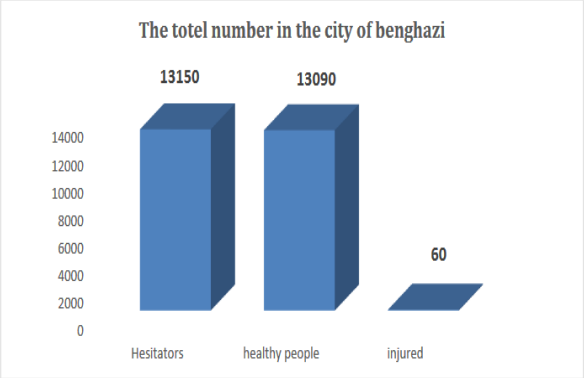

Figure (1a): It shows the total number of women attending medical centers Benghaziand the healthy and infected numbers.

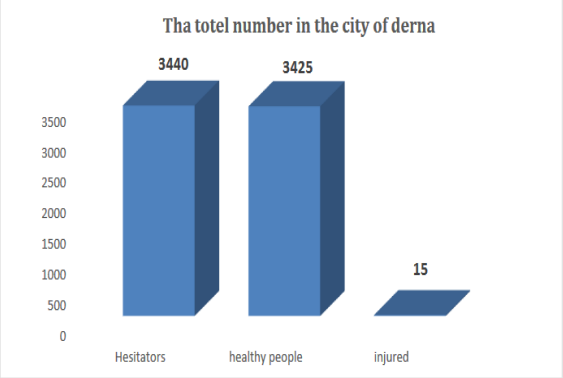

Figure (1b): It shows the total number of women attending medical centers and the healthy and infected numbers.

The study results indicated that the percentage of women with placenta previa in the city of Benghazi during one year was (0.05%), and in the city of Derna, it was (0.43%) (Fig. 2a.b).

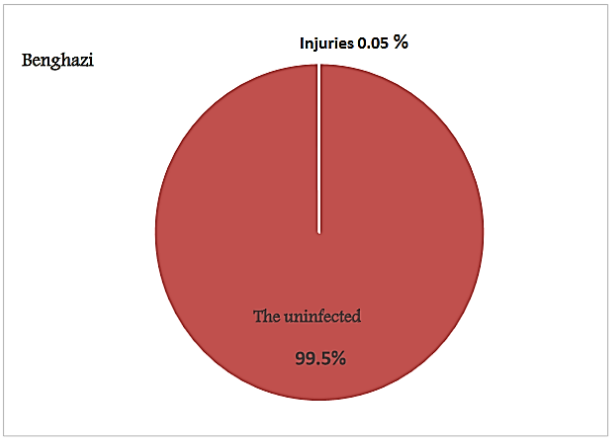

Figure (2a): It shows the percentage of women with placental abruption in the city of Benghazi

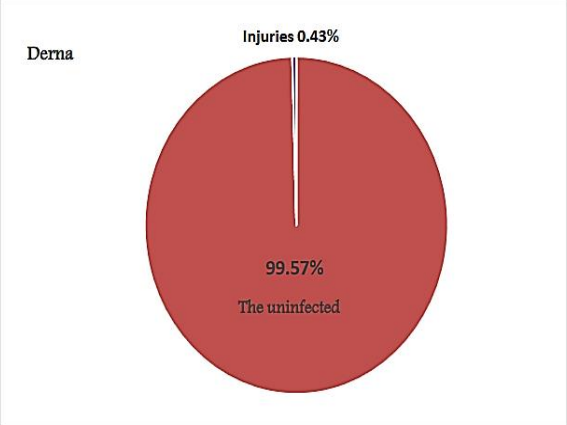

Figure (2b): It shows the percentage of women with placental abruption in the city of Derna

It became evident through this study that the most affected age group among pregnant women was between 35 and 40 in both the cities of Benghazi and Derna. In Benghazi, (34) cases, constituting 56.66%, belonged to this age group, while in Derna, (8) cases, accounting for 53.33%, fell within the same age bracket. This suggests a direct correlation, indicating that the greater the age, the higher the chances of developing placental abruption (Fig. 3a.b).

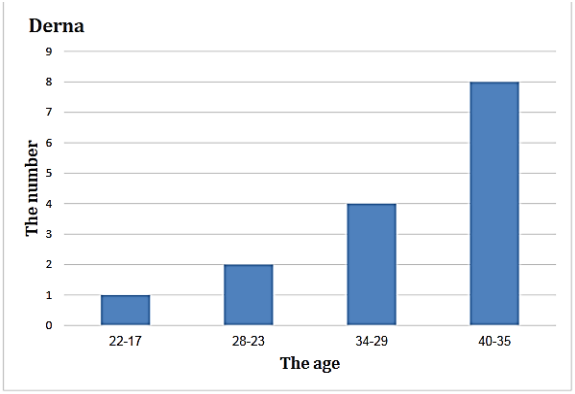

Figure (3b): It shows the age group most affected by placenta previa in the city of Derna.

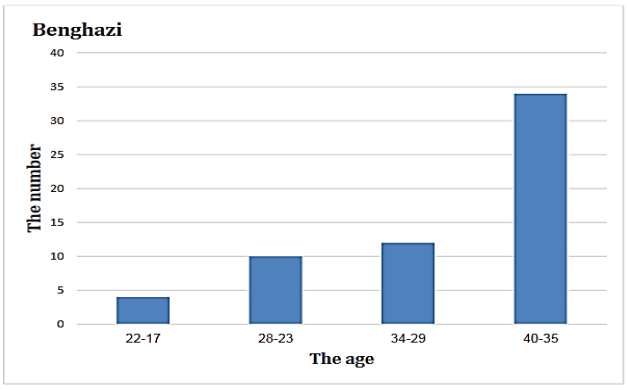

Figure (3a): It shows the age group most affected by placenta previa in the city of Benghazi.

Furthermore, the study observed that the most vulnerable women were those pregnant for the fifth time. In Benghazi, their number was (30), representing 50%, and in Derna, their number was (7), representing 46.66% (Fig. 4a.b).

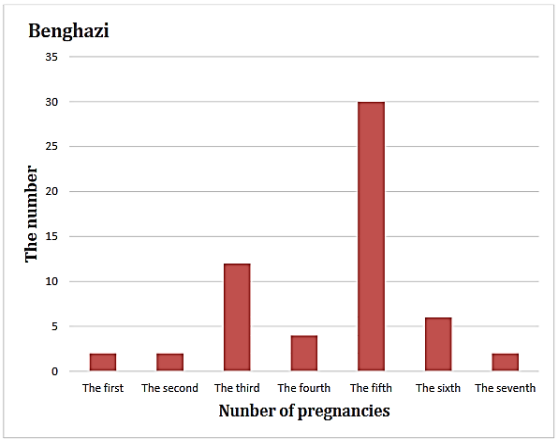

Figure (4a): Shows infection in the number of pregnancies in the city of Benghazi.

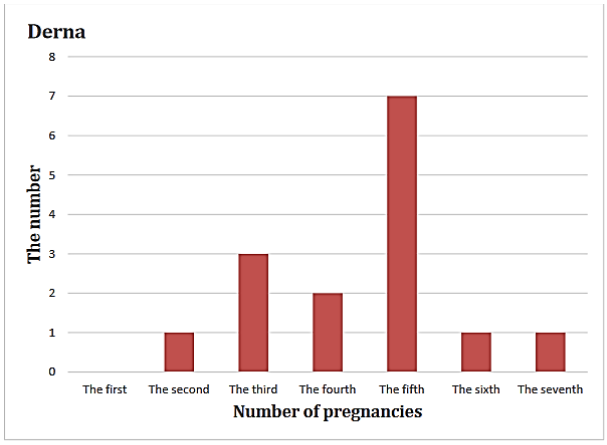

Figure (4b): Shows infection in the number of pregnancies in the city of Derna.

In this study, it was found that the largest share of exposure to infection was in the seventh month of pregnancy, as their number in the city of Benghazi was (37) , i.e. (61.66%), and in the city of Derna, their number was (6) , i.e. (40%) Fig 5 (a.b).

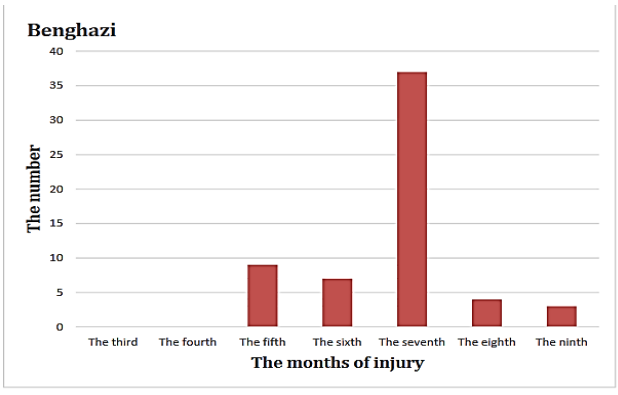

Figure (5a): It shows that the largest share of exposure to infection was in the seventh month of pregnancy in the city of Benghazi.

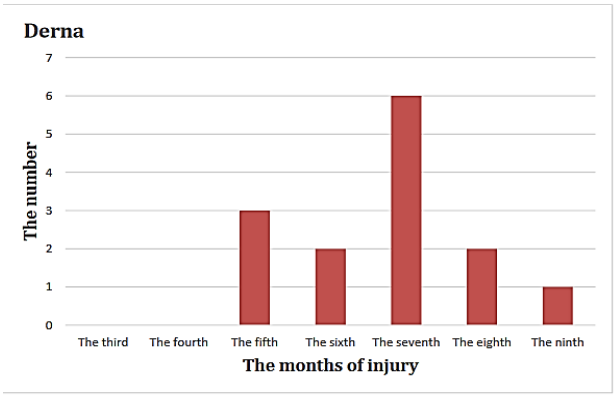

Figure (5b): It shows that the largest share of exposure to infection was in the seventh month of pregnancy in the city of Derna.

The results of the questionnaire on the causes of placental abruption showed that the most important reasons are previous caesarean sections (66.66%) in the city of Benghazi, and (46.66%) in the city of Derna. Then it is followed by the second reason, which is pregnancy between the ages of 35-40, (50%) in the city of Benghazi, and (46.66%) in the city of Derna. In addition to other reasons. Fig 6.

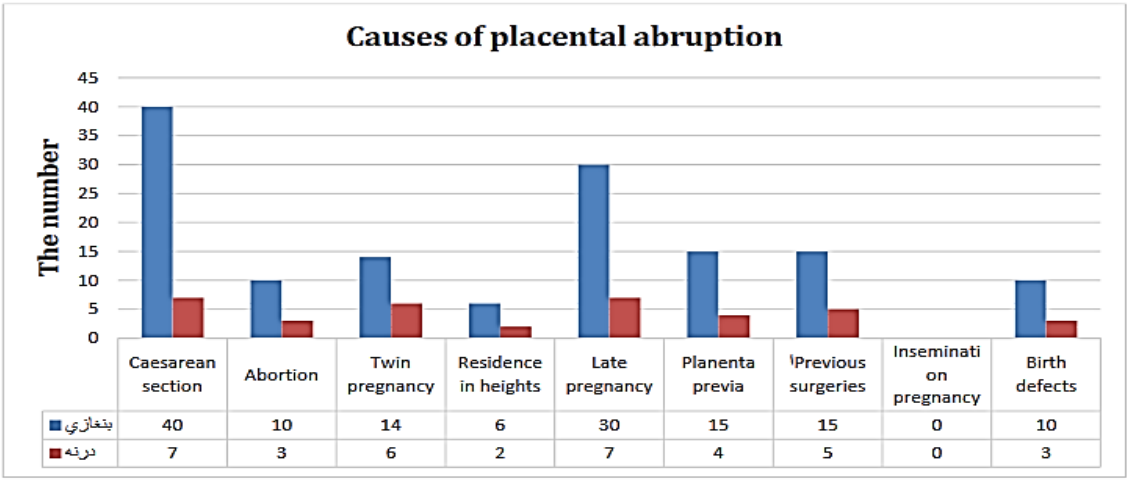

Figure (6): Explains the most important reasons for placental abruption in the city of Benghazi and Derna.

In this research, information was collected from infected women after childbirth, and the information focused on the type of childbirth and that the time of childbirth, as it was found that all cases in both cities were caesarean section (100%), Fig 7(a.b). And that the time of childbirth was most of them in the ninth month, i.e. (75 %) in the city of Benghazi, and (73.33%) in the city of Derna. Fig 8 (a.b). Information was also taken about the health status of the mother's womb after childbirth, as it was found that (8) cases out of (60) in the city of Benghazi, i.e. (13.33%), and one case out of (15) in the city of Derna, i.e. (6.66%), had a hysterectomy. Fig 9 (a.b).

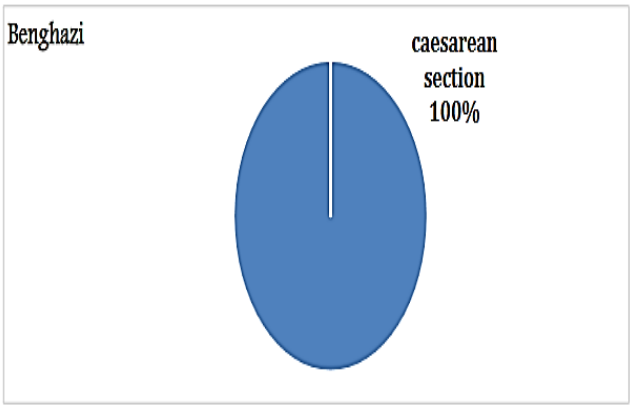

Figure (7a): Shows the type of childbirth for the injured women in the city of Benghazi..

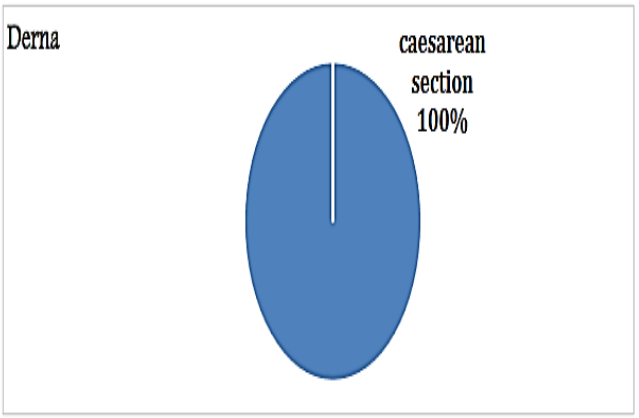

Figure (7b): Shows the type of childbirth for the injured women in the city of Derna.

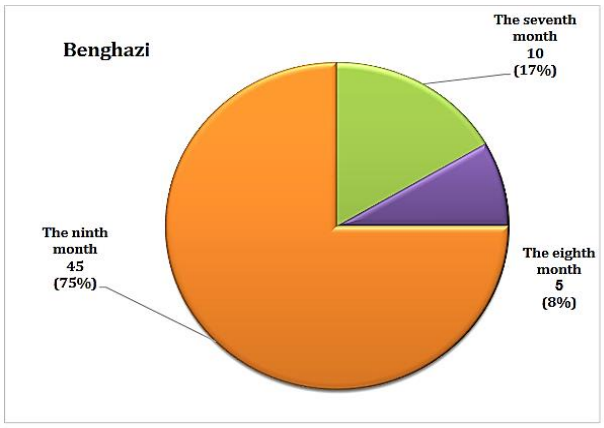

Figure (8a): Shows the time of delivery for infected women in the city of Benghazi.

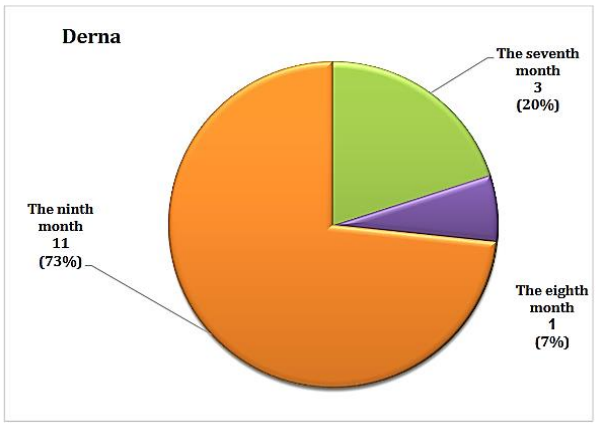

Figure (8b): Shows the time of delivery for infected women in the city of Derna.

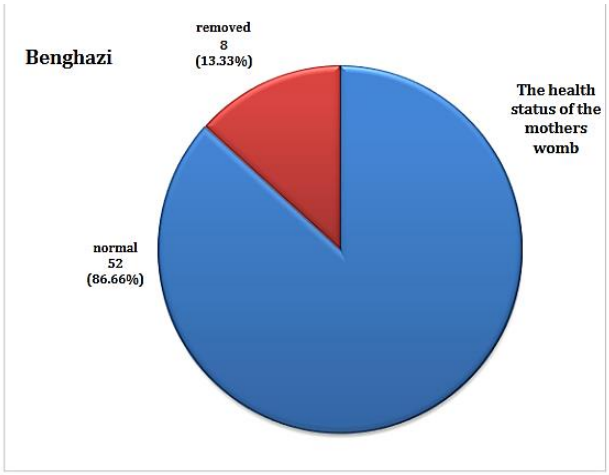

Figure (9a): Shows the health status of the mother's womb after childbirth, Benghazi city.

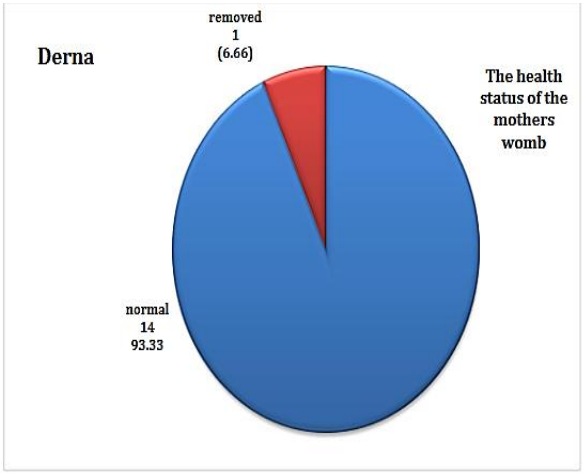

Figure (9b): Shows the health status of the mother's womb after childbirth, Derna city.

In addition to the above, I took the necessary information about the health of children, as it was found that the number of deceased children in the city of Benghazi was (3) children, i.e. (5%). while there were no deaths in the city of Derna, i.e. (0%). Fig 10 (a.b).

Finally. The sex of the children was counted, as the number of males was (22), i.e. (36.66%), the number of females was (33), i.e. (55%), the number of male twins was (2), i.e. (3.33%), the number of female twins 18 was (2), i.e. (3.33%), and the number of male and female twins was (1), i.e. (1.66%), in the city of Benghazi. In the city of Derna, the number of males was (4), i.e. (26.66%), the number of females was (9), i.e. (60%), the number of male twins was (0), i.e. (0%), the number of female twins was (1), i.e. (6.66%), and the number of male and female twins was (1), i.e. (6.66%). Fig 11 (a.b).

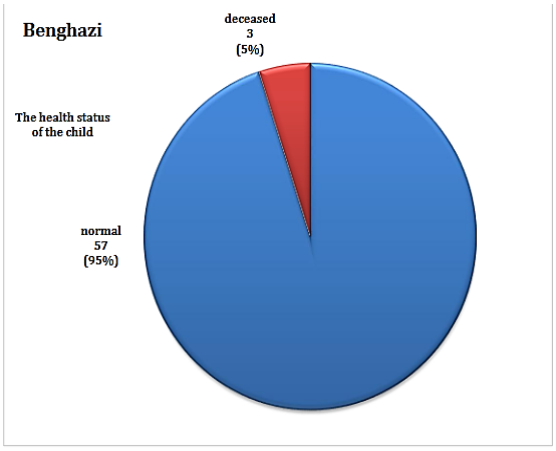

Figure (10a): Shows the number of children who died after birth in the city of Benghazi due to placental abruption.

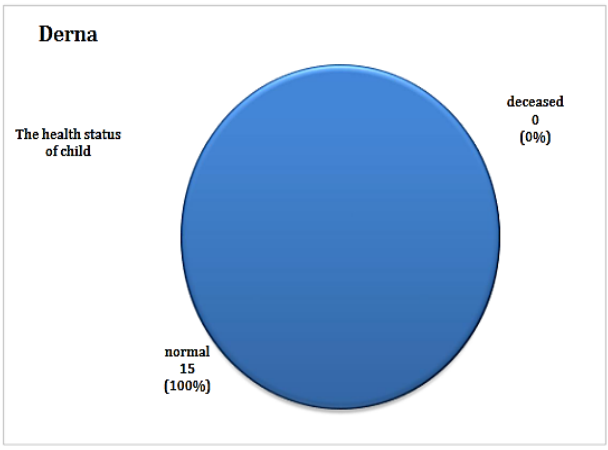

Figure (10 b): Shows the number of children who died after birth in the city of Derna due to placental abruption.

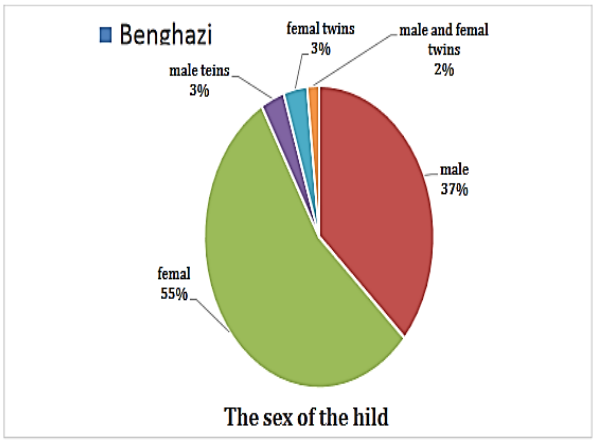

Figure (11a): It shows the gender and number of children born to infected women in the city of Benghaz.

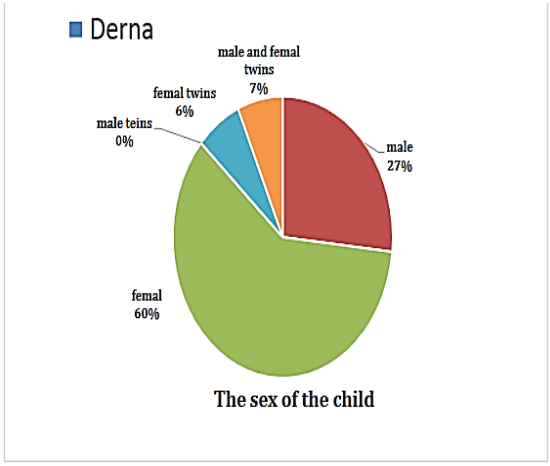

Figure (11 b): It shows the gender and number of children born to infected women in the city of Derna.

4. DISCUSSION

Establishing the causes and understanding the mechanisms of preeclampsia is crucial for developing preventive measures and treatment protocols. Despite extensive research, preeclampsia remains a leading cause of maternal mortality globally, and the absence of a reliable screening test or effective treatment adds to its challenges (Bdolah et al., 2005). In pregnancies complicated by hypertension, various changes in placental villi occur, directly correlating with the disease's severity. The perinatal outcome worsens with advancing grades of pregnancy-induced hypertension (Kurdukar et al., 2007). The study's findings revealed that the prevalence of placenta previa in both cities did not exceed 0.05% during one year, aligning with previous research estimating a prevalence rate of approximately 5 per 1000 pregnancies globally (Rosenberg et al., 2011).

Furthermore, the study highlighted that the most affected age group among pregnant women in both cities was between 35 and 40 years, with an average percentage of 55%. This suggests a direct relationship, indicating that advanced maternal age increases the likelihood of developing placental abruption. This finding resonates with earlier studies, emphasizing a significant increase in the risk of placenta previa with maternal age over 40, compared to women under 20. Advanced maternal age is also independently associated with an elevated risk of uterine cancer (Ananth, 1996). In conclusion, these insights underscore the need for targeted interventions and monitoring, particularly for pregnant women in the identified age group, to mitigate the risks associated with placental complications. Further research is imperative to delve into the specific mechanisms and risk factors contributing to these observed patterns. During this study, a noteworthy observation was that women pregnant for the fifth time were identified as the most vulnerable, constituting an average percentage of 48% in both cities. Additionally, the highest exposure to infection occurred in the seventh month of pregnancy, aligning with existing literature (Ananth, 1996) indicating increased risks of placental abruption during the fifth and sixth pregnancies, with a peak between the sixth and seventh months. The questionnaire results on the causes of placental abruption emphasized the significance of previous cesarean sections as the most crucial factor, followed by pregnancy between the ages of 35-40, consistent with findings from Rosenberg et al. (2011). Women with placenta previa faced a fourfold increased risk of vaginal bleeding or previous cesarean sections, often necessitating early cesarean sections and hysterectomy due to life-threatening bleeding, with risks escalating after the age of 35 (Rosenberg et al., 2011). In both cities, the study noted that 100% of deliveries were through cesarean sections, with the majority occurring in the ninth month (74%). This concurs with Wortman et al. (2016), highlighting the adoption of cesarean sections for cases involving pathological conditions and the increased risks of blood transfusion and admission to the intensive care unit for mothers. Furthermore, the study revealed that 14% of infected women required hysterectomy in both cities. Information about children's health indicated that in Benghazi, three children (5%) did not survive, underlining the serious consequences associated with placental complications. These findings underscore the importance of vigilant monitoring and tailored interventions for women in high-risk categories, emphasizing the need for preventive measures and early detection to mitigate the adverse outcomes associated with placental abruption. Further research is essential to delve into the nuances of these risk factors and their impact on maternal and fetal health. In the city of Derna, no deaths were reported, indicating a 0% mortality rate. This aligns with a previous study suggesting an increased risk of complications, such as hysterectomy, septicemia, thrombophlebitis, and maternal death, particularly associated with caesarean sections. These complications may arise from various factors, including placental site lesions, cervix or vagina issues, and sometimes fetal origins (Mata et al., 2015). The study also emphasizes that placenta previa and placental abruption represent significant contributors to maternal and fetal morbidity and mortality, affecting 2-5% of all pregnancies (Sinha and Kuruba, 2008). This underscores the critical need for early detection, comprehensive management, and preventive measures to address the potential complications associated with these conditions. While the absence of deaths in Derna is a positive aspect, the overall risks and complications associated with placental complications emphasize the importance of ongoing research and tailored interventions to improve outcomes for both mothers and infants. Further investigations are warranted to explore specific risk factors and refine strategies for prevention and management.

5. CONCLUSION

In conclusion, placenta previa and the separation of the placenta from the uterine wall emerge as significant contributors to maternal and fetal morbidity and mortality, either partially or completely. These conditions can lead to maternal bleeding and compromise the baby's oxygen and nutrient supply. Risk factors encompass high blood pressure, abdominal trauma, substance abuse, cervicitis, genital trauma, tumors, infections, and coagulation defects, emphasizing the importance of prompt medical intervention.

A comparison between robust and fragile healthcare systems underscores the crucial role of strong healthcare systems in providing safe, timely, and appropriate cesarean deliveries. Optimal health outcomes for both mothers and newborns during emergency obstetric situations can be achieved through such systems.

As a final recommendation, we emphasize the necessity for further research to identify effective strategies for preventing and treating placenta previa and placental abruption among affected women. This ongoing research is vital for enhancing our understanding of these conditions and refining approaches to minimize their impact on maternal and fetal health.

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