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Fetal outcomes in traditional gold mining areas, Sudan.

Nawal Ali Ahmed Mohamed[1,2,3,4] Manahil Shogar[5] Hala Ibrahem[5] Ahmed Abdelkerim Ahmed Abdallah[1,2,6] Haitham Abdalla Ali Ismail[1,2,4] Ahmed Amin Mohammed[1,2,9] Hussain Gadelkarim Ahmed[7,8]

[1]Ministry of Health, El-Obeid Obstetrics and Gynecology teaching Hospital, El-Obeid, Sudan.

[2]Department of Obstetrics and Gynecology, Faculty of Medicine, University of Kordofan, NK, El-Obeid, Sudan.

[3]Shikan College El-Obeid, Sudan.

[4]Arous Elrimal Obstetrics, Gynecology, and Laparoscopy Surgery Clinic, El-Obeid, Sudan.

[5]Department of Biockemesry, Faculty of Medicine, University of Kordofan, El-Obeid, Sudan.

[6]Alfayhaa Obstetrics, Gynecology, and Laparoscopy Surgery Clinic, El-Obeid, Sudan.

[7]Prof Medical Research Consultancy Center- MRCC, El-Obeid, Sudan.

[8]Department of Histopathology and Cytology, FMLS, University of Khartoum, Sudan.

[9]Highcare Specialized Clinic, El-obied, Sudan.

Abstract

Background: Pregnancy during heavy metal toxicology is associated with various unfavorable consequences for both the mother and the fetus. Therefore, the aim of this study was to assess the fetal outcomes for pregnant women living in traditional gold mining areas in North Kordofan, Sudan. **Methodology:** The Obstetrics and Gynecology Teaching Hospital in North Kordofan State, El-Obeid City, Sudan, conducted this descriptive transaction case-control study from January 2018 to December 2023. The distribution of the 270 study participants was as follows: About 135 patients from traditional gold mining areas attended El-Obeid Obs. @ Gyn. Teaching Hospital for maternity services, and another 135 from non-gold mining areas as a control. **Results:** The average baby weight was 2.5–3.5 kg for 98 (83.7%) of the cases and 77 (74.7%) of the controls. Most study participants had healthy babies. The study involved 85 (44%) cases and 79 (65%) controls, with NICU admission following each case. 16(12%) of the cases and 18(14%) of the controls give birth to stillborn babies; 12(9%) and 6(5%) of the controls give birth to nonviable babies; 14(11%) and 18(14%) of the controls give birth to nonviable babies; and 4(3%) and 3(2%) of the controls give birth to congenital malformed babies. **Conclusion:** Exposure to these elements has altered the fetal development of pregnant women in traditionally gold-mining areas in Sudan.

Keywords: pregnancy, traditional gold mining, fetal outcomes.

Correspondence to: Nawal Ali Ahmed Mohamed Email:nawalaliahmed79@gmail.com
Orcid Id: 0009-0005-8695-8344

Introduction

Heavy metal exposure during pregnancy poses many risks to pregnant mothers and their unborn children [1]. Rapid industrialization has generated environmental heavy metal pollution, which harms human health and increases illness risk [2].

Adverse birth outcomes such as SGA, low birth weight, and preterm birth have been associated with lead (Pb), zinc (Zn), mercury (Hg), arsenic (As), cadmium (Cd), cobalt (Co), and copper. The findings link heavy metal exposure to poor pregnancy outcomes [3]. Prenatal exposure to toxic metal combinations may promote neural tube abnormalities. NTDs affect about 300,000 pregnancies globally. Environmental factors, such as heavy metal pollution, can affect pregnancy and endanger the fetus and future generations. Heavy metals affect cell growth, differentiation, proliferation, apoptosis, and damage repair. Reduced antioxidant defenses, ROS, oxidative stress, and enzyme inactivation make heavy metals hazardous [8]. In Merowe-city, Northern Sudan, fish and hen eggs contain zinc, lead, cadmium, manganese, and iron at quantities beyond legal limits [13].

Despite the growing epidemiologic literature on the relationship, no systematic review has taken place [4]. Hg exposure during artisanal gold mining may harm neonatal health; however, a tiny birth cohort study in Madre de Dios, Peru, South America, found that heavy metals and minerals affect baby health [5]. Researchers have also linked prenatal Hg exposure to high systolic blood pressure at age seven [6].

Early Pb exposure may cause neurological changes later in life due to epigenetic imprint alteration and endogenous Pb exposure. Oxidative stress from immunologic activation, epigenetic alterations, and direct neurochemical effects causes neurotoxicity [7].

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This research examines pregnancy outcomes for women in traditional gold mining communities who attend El-Obeid Obstetrics and Gynecology Teaching Hospital maternity clinics in North Kordofan, Sudan.

Material and methods:

This is a descriptive transaction case-control study that took place between January 2018 and December 2023 at the Obstetrics and Gynecology Teaching Hospital in North Kordofan State, El-Obeid City, Sudan. The study population consisted of 270 participants, distributed as follows: The study included approximately 135 cases from traditional gold mining areas who were attending maternity services at El-Obeid Obs. & Gyn. Teaching Hospital, and another 135 control participants from non-gold mining areas, ranging in age from 15 to 46 years, with a mean age of 27.48 years (27.19) for the case group and 27.78 for the control group. Hospital patient records, providing complete coverage of patients over the specified period, serve as the sample source.

Statistical Analysis: We produced this data in a spreadsheet and then loaded it into a computer software statistical package for social sciences (SPSS) (Version 24, Chicago, USA). We calculated frequencies, percentages, cross-tabulations, and the Chi square test. We computed the P-value using the 95% confidence interval (95% CI). P-values less than 0.05 were considered statistically significant.

Ethical Approval:

The Human Research Ethics Committee (HREC) of the Prof. Medical Research Center (MRCC) approved the study proposal. (Approval No. 0003/MRCC.02/24).

Results:

This study involved 270 people, with 135 from traditional gold mining areas serving as cases and 135 from other areas serving as controls. The average age of the study group was 27.48 years, with a range of 15 to 46 years. The case group's mean age was (27.17), while the control group's mean was (27.78). In this study, the majority of participants were aged 21–30 years (66 (48.8%) of the cases and 69 (51.4%) of the controls), followed by those aged 31–40 years (33 (24.4%) of the case group and 42 (31.3%) of the control group. Those under the age of 20 made up 32 (23.7%) of the cases and 20 (14.9%) of the controls, while the fewest participants were over 40 years (4 (2.9%) of the cases and 3 (2.2%) of the controls). The majority of the studied population resides in rural areas. Table 1 and Figure 1 describe that 87 (64.4%) of the cases and 94 (69.6%) of the controls remain in urban areas.

Table 1. Distribution of the study population by demographic characteristics

Age	Cases	Controls	Total
≤ 20 years	32	20	52
21 - 30	66	69	135
31 - 40	33	42	75
≥40	4	3	7
Total	135	134	269
Residence			
Urban	48	41	89
Rural	87	94	181
Total	135	135	270

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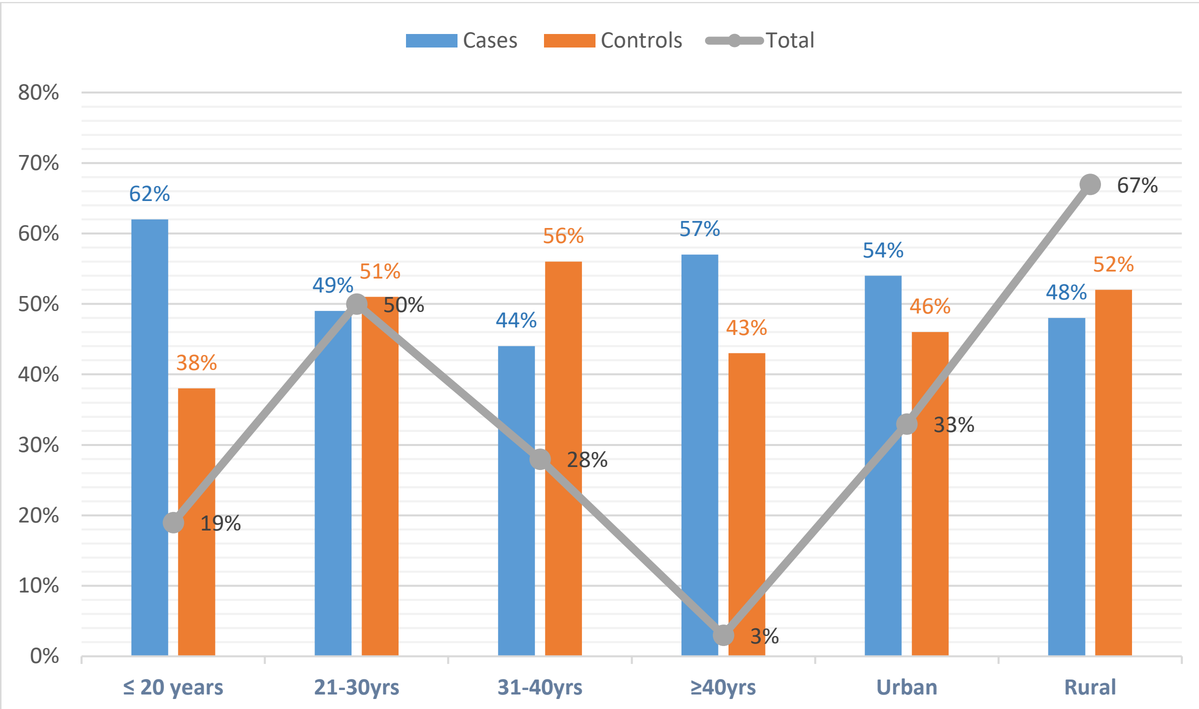

Figure 1: depicts the participants' demographic characteristics.

Table 2 and Figure 2 describe the study's patients' distribution by gestational age. Most subjects presented with GA at 37–42 weeks. 83 (66.4%) of cases and 77 (58.3%) of controls, followed by 27–36 weeks. 33 (26.4%) of the cases and 31 (23.4%) of the controls were fewer than 26 weeks old, with 9 (7.2%) of the cases and 24 (18.1%) of the controls falling into this category.

Table 2: Distribution of the Study Population by Gestational Age

Variable	**Cases**	**Controls**	**Total**
Gestational age			
<26 weeks	9	24	33
27-36	33	31	64
37-42	83	77	160
Total	125	132	257

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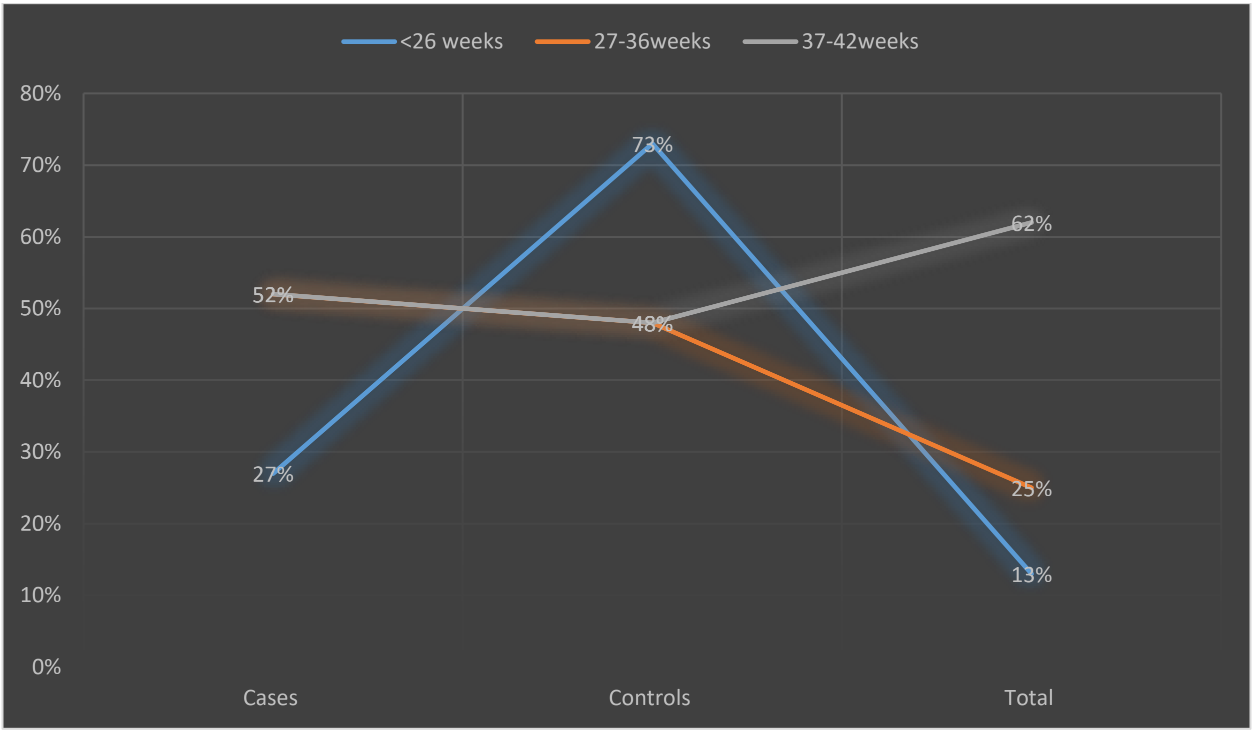

Figure 2: Description of Participants by Gestational Age

38 (32.4%) of the case group and 49 (47.5%) of the control group underwent elective caesarean section ELC/S, while 47 (40.1%) of the cases and 35 (33.9%) of the controls underwent emergency caesarean section. 23 (19.6%) of the cases underwent spontaneous vaginal delivery, and 9 (8.7%) of the controls did the same. The remaining cases underwent preterm delivery (PTD), vaginal birth after C/S (VBAC), and induction of labor (IOL), accounting for 5 (4.2%) and 2 (1.7%).

Table 3: Distribution of Study Population by Mode of Delivery

Mode of delivery	Cases	Controls	Total
Preterm delivery	5	6	11
Spontaneous vaginal delivery	23	9	32
Emergency C/S	47	35	82
Elective C/S	38	49	87
Vaginal birth after C/S	2	1	3
Induction of labor	2	3	5
Total	117	103	220

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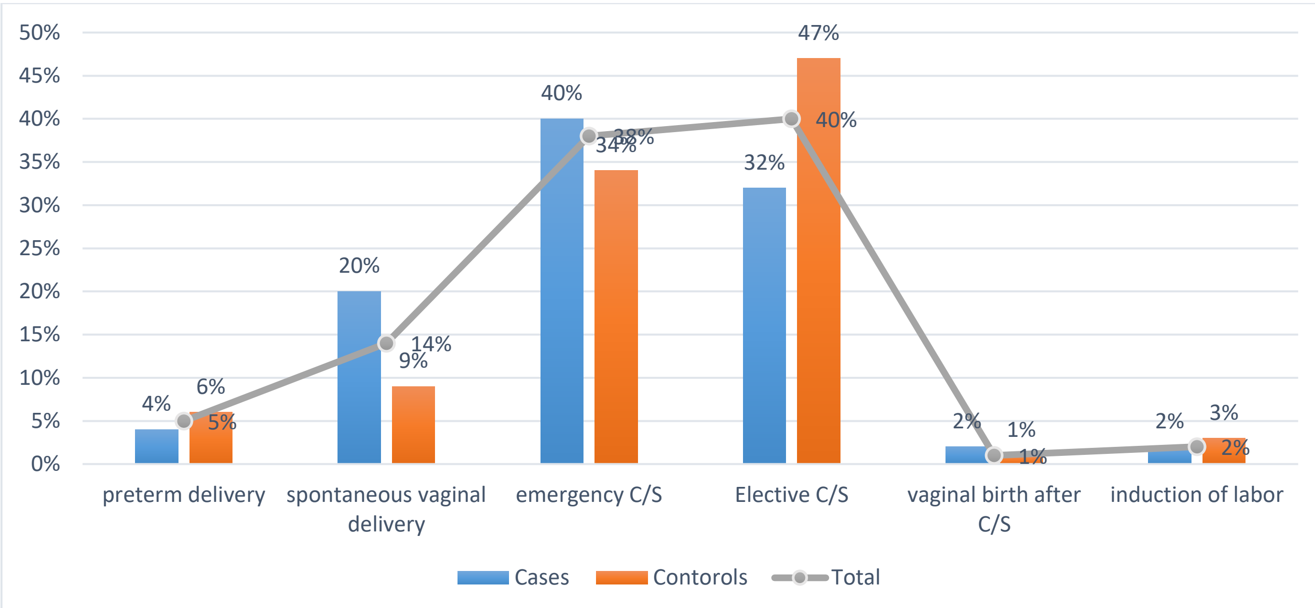

Figure 3: Description of the Study Population by Mode of Delivery.

The majority of the study population gave birth to a baby weighing 2.5–3.5 kg (98.7% of the case group and 77.7% of the control group), followed by less than 2.4 kg (15.8% of the cases and 17.5% of the controls) and more than 3.6 kg (4.4% of the cases and 9.7% of the controls). The majority of the participants give birth to a girl baby (48.6% of the cases and 57.7% of the controls), while 55.3% of the cases and 40.2% of the controls have a male kid.

Table 4: shows the distribution of the study population based on fetal weight and gender.

Variable	Cases	Controls	Total
Fetal weight			
< 2.4 kg	15	17	32
2.5-3.5 kg	98	77	175
> 3.6 kg	4	9	13
Total	117	103	220
Fetal gender			
male	55	40	95
female	48	57	105
Total	103	97	200

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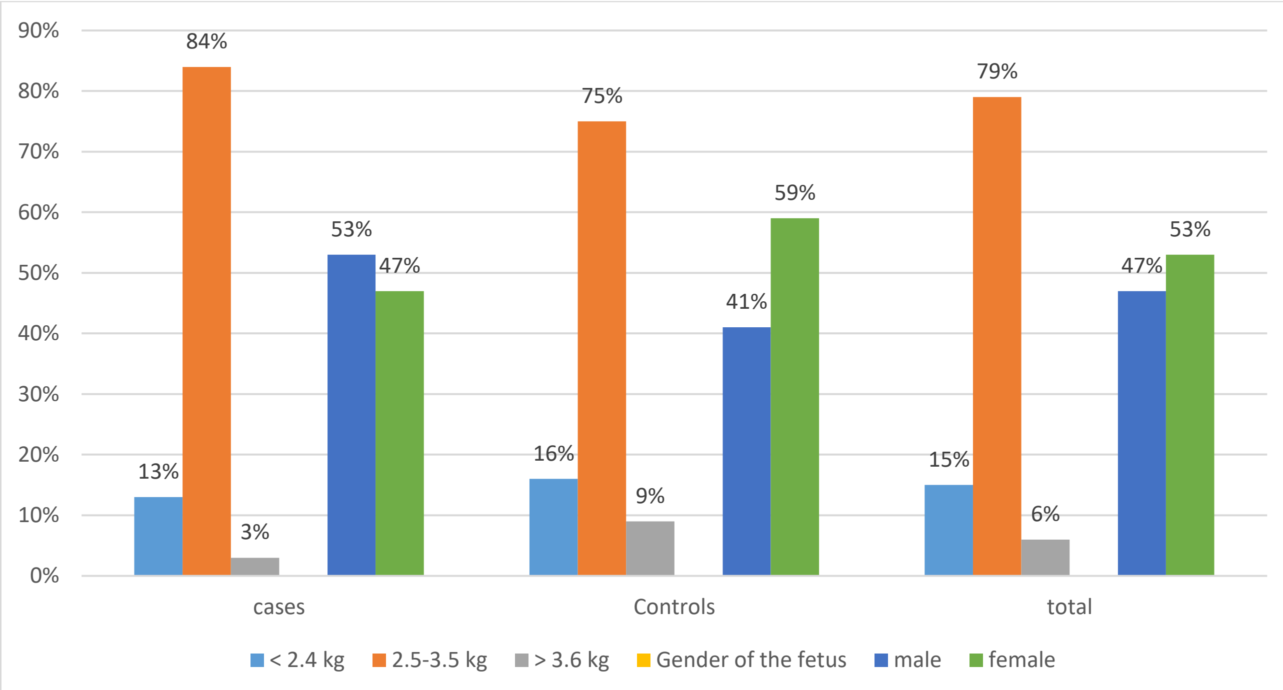

Figure 4. description of the study population by weight and gender of the fetu .

Table 5. Distribution of the study population by fetal outcomes

Variable	Cases	Controls	Totals
Fetal outcomes			
Alife and well	85	79	164
NICU admission	16	18	34
Congenital malformation	4	3	7
Stillbirth	12	6	18
Early pregnancy loss	14	18	32
Total	131	124	255

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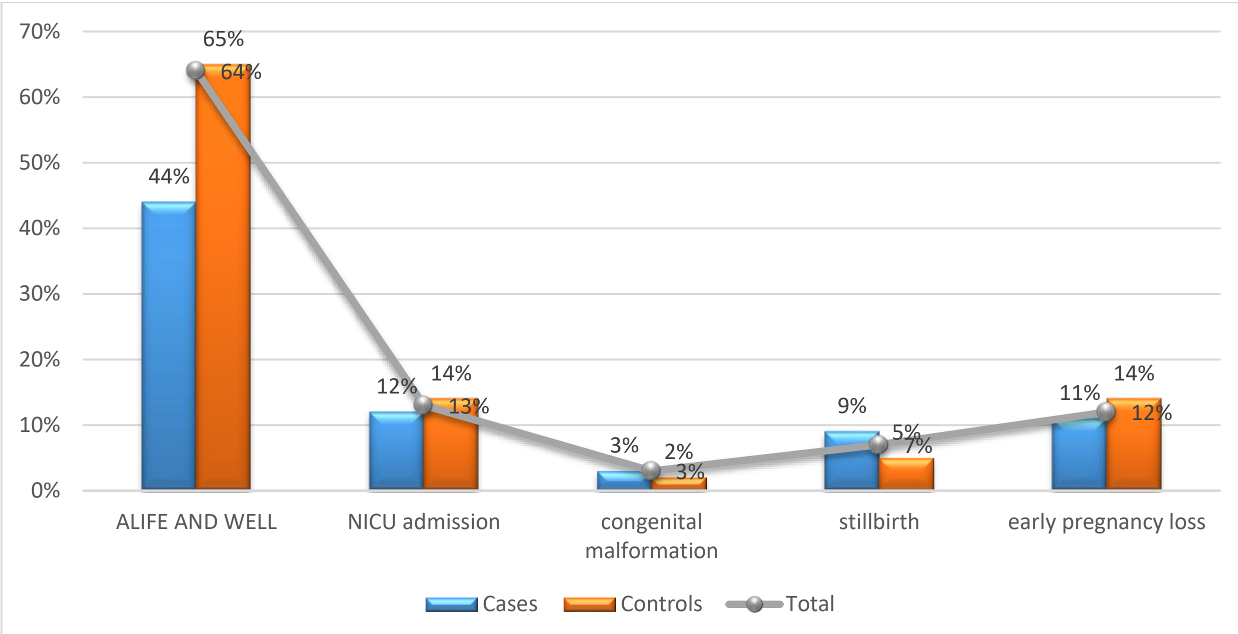

Figure 5: Description of the Study Population by Fetal Outcomes.

Most of the study population gives birth to live and healthy kids. 85 (44%) of the case group and 79 (65%) of the control group are admitted to the NICU. 16(12%) of the cases and 18(14%) of the controls gave birth to stillborn babies, while 12(9%) of the cases and 6(5%) of the controls had nonviable outcomes. 14 (11% of the cases) and 18 (14% of the controls) gave birth to congenitally deformed babies, with the lowest group experiencing this condition. Four (3%) of the cases and three (2%) of the controls gave birth to congenitally deformed babies.

Discussion:

Heavy metals, such as cadmium, lead, and mercury, exert a high level of toxicity, which results in several health risks for pregnant women and the fetuses that are developing inside their uteruses [9]. There is widespread recognition of the specific impact that heavy metal exposure has on pregnant women's health and the risks it poses to their newborn children. Researchers have established a correlation between heavy metal exposure and reduced birth weight, increased preterm delivery rates, low Apgar scores, and non-traumatic birth defects (10, 15). Researchers conducted studies in Alhasahis, Maringan, and Marawi, compiling their findings. The Alhasahisa region had the highest median amount, 21.5 mg/kg. This level fell below the established maximum acceptable limits of 50 mg/kg [14].

The goal of this study was to investigate the outcomes of pregnancies among women who had fled traditional gold mining areas in the state of North Kordofan, which is located in western Sudan. Many participants in this study were young women between the ages of 21 and 30. The study affected 48.8 percent of cases and 51.4% of controls. In addition to this, the bulk of the people who participated in the survey live in rural areas. The survey affected 64.4% of cases and 69.6% of controls. Note that most cases presented between 37 and 40 weeks of gestation. A significant proportion of the early cases occurred between 27 and 36 weeks of gestation, accounting for 66.4% of the cases and 58.3% of the controls. According to [2], there was a correlation between maternal lead exposure, even at low concentrations, and a lower birth weight and a shorter gestation period in 26.4% of the cases and 23.4% of the controls.

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The control group had 33.9% of their deliveries performed by emergency caesarean section, while the case group had 40.1% of their deliveries performed by this method. The majority of the people who participated in the research project gave birth to a healthy infant weighing between 2.5 and 3.5 kilograms (83.7% of the case group and 74.7% of the control group). On the other hand, those who gave birth to infants weighing less than 2.4 kilograms made up 12.8% of the cases and 16.5% of the controls, and there were no statistically significant differences between the two groups. The gender of the female individuals was the most prevalent outcome in 46.6% of cases and 58.7% of controls. Less than half of the people who participate in the case group are able to give birth to live and healthy children. 44% of the control group, in contrast to 65% of the control group, suggest statistically significant differences. In addition, 12% of the cases and 14% of the controls require admission to the neonatal intensive care unit (NICU); a subset of the participants, specifically 9% of the cases and 5% of the controls, give birth to stillborn babies; and a very small percentage of participants give birth to congenital malformed newborns. Two percent of the controls and three percent of the cases had outcomes that were not viable, such as a miscarriage, an ectopic pregnancy, or a molar pregnancy. 14% of the controls and 11% of the cases experienced such outcomes. The purpose of this research is to address the underregistration of early pregnancy loss in traditional mining communities, as described in dealing with additional challenges. The majority of miscarriages occur without any interaction with the formal healthcare system, leading to their lack of registration [12]. Research links accidental exposure to heavy metals during pregnancy to prenatal congenital deformities, miscarriages, and even stillbirth.

According to the findings of a study that was carried out in Benin City, also known as South-South Nigeria [11], pregnant women who experienced negative pregnancy outcomes showed a close association with hazardous metals.

Pregnant women in middle- and low-income countries are particularly vulnerable to the harmful effects of heavy metals due to inadequate regulation of industrial and agricultural chemicals and residues.

Conclusion:

Exposure to these elements has altered the fetal development of pregnant women in traditionally gold mining areas in Sudan. Interventions at all levels are urgently required to alleviate the impact of these health conditions.

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Conflict of interest: Authors declare that no conflict of interest.

Data Availability: Data regarding this research is available and can be requested from the corresponding authors.

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