The Adequacy of Antioxidant Intake of Pregnant Women in Artisanal Small-Scale Gold Mining in Encountering Pandemic Condition

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Abstract. Background: The antioxidant is a nutrient that is needed to encounter free radicals produced by internal metabolism and also from the environment. In artisanal small-scale gold mining areas, environmental pollution, particularly mercury, could be the source of the free radical agents. Besides pollution, they have to combat Sar-cov2 in pandemic conditions. Pregnant women in the ASGM area should have adequate antioxidant levels to avoid mercury intoxication and infection.

Objective: The objective of this research was to find out the adequacy of antioxidant intake of pregnant women in the ASGM areas.

Method: This research conducted a cross-sectional research design. A nutritional interview using 24-h food recall was performed and followed by a nutrisurvey analysis to reveal the antioxidant intake of pregnant women. 130s subject which has met the criteria were enrolled. The antioxidant adequacy was analyzed by the dietary value compared to recommended dietary allowance.

Result: The mean intake for vitamin A was 1023.01 μg, vitamin E was 6.61 mg, and vitamin C was 127.62 mg. While antioxidants from mineral derivate; Iron was 8.00 mg, Zinc was 4.25 mg, Copper was 0.99 mg, and Manganese was 4.70 mg. If the result compared to Indonesian nutritional adequacy, it was found that vitamin A met the nutritional adequacy, while other vitamins did not meet the adequacy. For minerals, Manganese was adequate, but other minerals did not meet the adequacy.

Conclusion: Antioxidant dietary intake of pregnant women in the ASGM area did not meet the nutritional adequacy level, except for vitamin A and Manganese. These levels were not sufficient to avoid mercury intoxication and infection.

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Keywords: antioxidant dietary intake · artisanal small-scale gold mining · nutritional adequacy · pregnant women

1 Introduction

Vitamins and minerals are essential micronutrients needed for normal body function, for example, body fluid homeostasis, and for generating optimal metabolism since vitamins and minerals are building the holo-enzyme structure, providing optimal antioxidants and other important roles [1–3].

To perform their function, vitamins and minerals have to meet the requirement. Such kinds of conditions caused an increased need for vitamins and minerals. Pregnancy is a condition with a higher requirement of nutrients demanded compared to other periods of life since the mother has to fulfill the body's requirements and also for the fetus [4].

Women who lived in artisanal small-scale gold mining (ASGM) accepted two conditions nowadays that are pandemic situation and mercury exposure. Ekawanti et al. (2019) found that 58.82% of pregnant women who lived in the ASGM area in West Sumbawa had high mercury levels (≥5 μg/L) [5]. In the previous study, Ekawanti and Krisnayanti (2015) demonstrated that high mercury concentration in urine (7–273.3 μg/L) and high mercury hair level (>1–12.93 μg/g) of gold miners and their families [6].

These conditions require a higher antioxidant capacity to avoid oxidative stress. Ekawanti et al. (2021) demonstrated that the antioxidants intake of school-age children in the ASGM areas did not meet recommended dietary allowance, and they were not adequate for facing mercury pollution [7]. Also, the study by Erol et al. (2021) showed that lower vitamin E increased elevated oxidative stress in the etiopathogenesis of COVID-19 and the relationship with composite adverse perinatal outcomes [8]. Chen et al. (2022) found that pregnant women in China have a daily intake of eggs and fish/shrimp below recommended ranges regardless of the pandemic severity [9].

The nutrition status of pregnant women in the ASGM areas during the pandemic situation is very important in managing dietary recommendations for health services to prevent the adverse effects of infection and mercury intoxication in pregnancy, so the study objective was to find out the adequacy of antioxidant intake of pregnant women in the ASGM areas in encountering pandemic situations.

2 Methods

This research was a community-based study. Data were collected by applying a cross-sectional design, that nutritional intake was taken in one period of time. A hundred person of subjects were enrolled as participants. All the participants must meet the inclusion criteria, which were pregnant women in the second and third semester period of the pregnancy who lived in an artisanal small-scale gold mining area for more than 6 months and agreed to participate by signing the informed consent form. The exclusion criteria should take out the pregnant women from their participation, that was, if the pregnant woman had hyperemesis, suffered from a thyroid disorder, and other severe

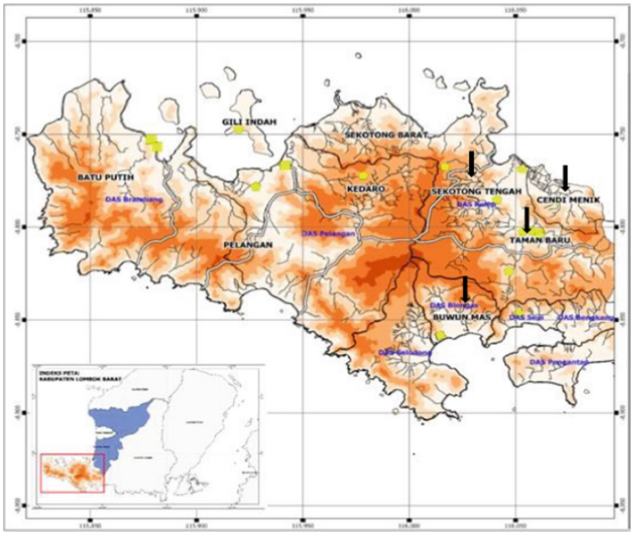

Fig. 1. Research's Location (Adaptation from Ministry of Environment and Forestry Map, 2021)

complications of her pregnancy**.** As many as 130s pregnant women were enrolled, more than minimal samples, namely 51 subjects.

This research was conducted from October 2021 until May 2022. The location of this study was in a subdistrict in West Lombok that was Sekotong – an artisanal small-scale gold mining area since 2008. The participants lived in four villages that were Cendi Manik, Sekotong Tengah, Taman Baru, and Buwun Mas. All the villages were mercury hotspot areas (Fig. 1).

The participants conducted a nutritional interview by enumerators and then filled out their daily intake in the form of a 24-h food recall. This interview was followed by nutrisurvey analysis to reveal the nutritional intake, including antioxidant intake. Nutritional intakes will be analyzed adequacy by comparing to a recommended dietary allowance of the Indonesian Ministry of Health and dietary requirements for the pandemic condition.

3 Results and Discussion

As many as 130s pregnant women who inhabit four villages in the Sekotong subdistrict participated in this research. The location where the participant lived was the gold processing location. Characteristics of the subject were summarized in Table 1.

Table 1 shows that most participants or subjects were in the group of age 19–29 years old (56%) and in the period of pregnancy in the third trimester (61%). The nutritional status of the subjects was not suffered from protein energy malnutrition (82.8%). The intake of antioxidants was recapitulated as shown in Table 2.

Table 2 demonstrates the mean intake of pregnant women generally, for further analysis using recommended dietary allowance as the following figure:

Table 1. Characteristic of Subjects

Characteristics	Percentage (%)
Group of age	
16–18 years old (G1)	8
19–29 years old (G2)	56
30–49 years old (G3)	36
Period of pregnancy	
Second trimester	39
Third trimester	61
Nutritional status (upper arm circumference)	
Chronic Protein and Energy Malnutrition	17.2
(<23.5 cm) Normal (>23.5 cm)	82.8

Table 2. Summary of Antioxidant Intake

Antioxidant	Mean intake
Vitamin A (μg)	1023.01
Vitamin E (mg)	6.61
Vitamin C (mg)	127.62
Iron (mg)	8.00
Zinc (mg)	4.25
Copper (mg)	0.99
Manganese (mg	4.70

Figure 2 indicates that the lowest intake of vitamin A was in the group age G1 (850.11 μg), lower than RDA (900.00 μg). The other group met the RDA value.

Figure 3 indicates that the lowest intake of vitamin E was in the group age G3 second trimester (4.76 mg), lower than RDA (15.00 mg). All groups did not meet the RDA value.

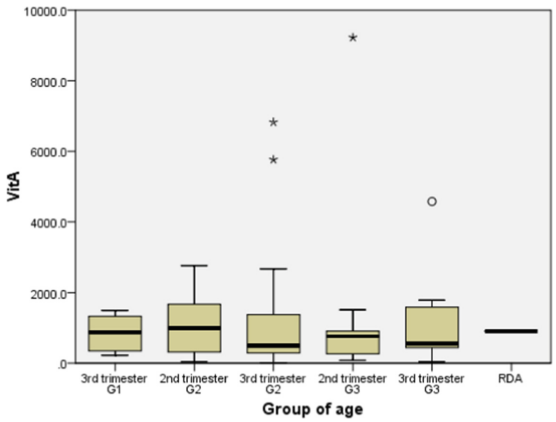

Fig. 2. Vitamin A dietary intake

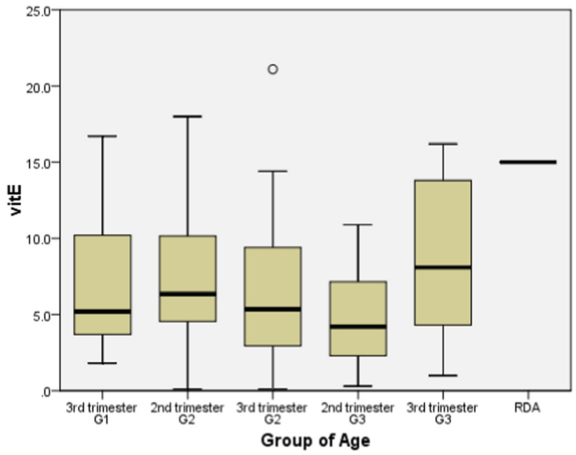

Fig. 3. Vitamin E dietary intake

Figure 4 shows that the lowest intake of vitamin C was the group of G3 second trimester (71.50 mg). Both periods of pregnancy in G3 have lower vitamin C intake compared to RDA (85 mg) (Fig. 5).

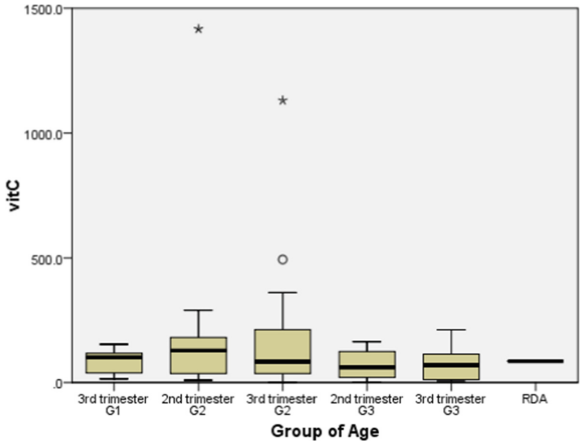

Fig. 4. Vitamin C intake

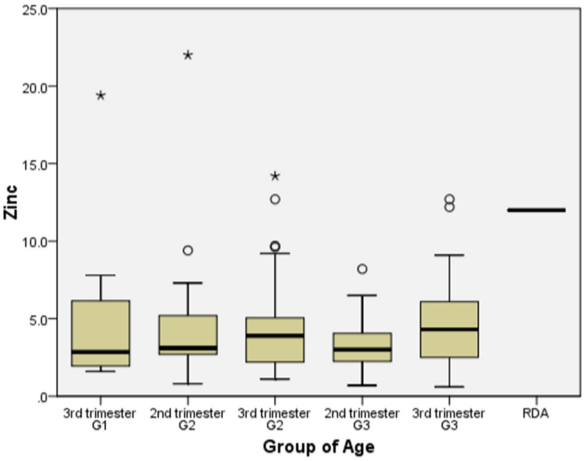

Fig. 5. Zinc dietary intake

The lowest Zinc intake was a group of G3 second trimester (3.33 mg). All groups did not meet the RDA value (12 mg) (Fig. 6).

Group G3's second trimester was the lowest intake of Copper (0.86 mg), while the RDA value was 0.9 mg, so all groups met the RDA value except group G3 (Fig. 7).

Intake for all group meet the RDA value (2.00 mg).

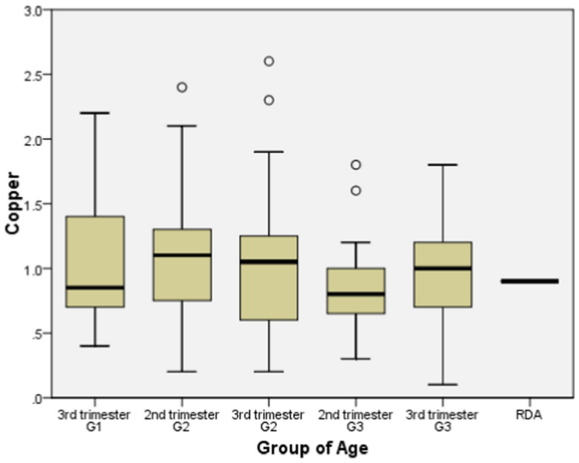

Fig. 6. Copper dietary intake

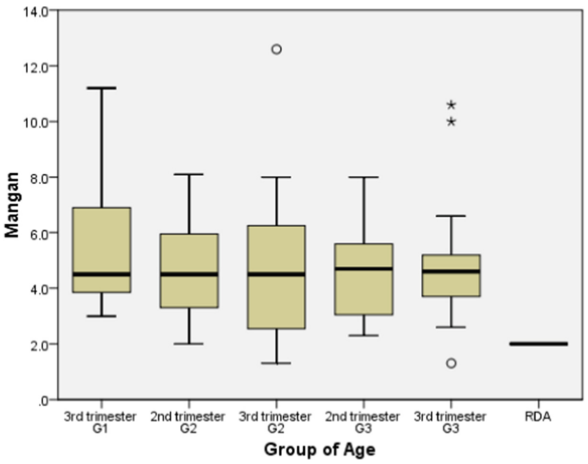

Fig. 7. Manganese dietary intake

4 Discussion

This study found that vitamins A and C met RDA values and also Copper and Manganese. This finding is parallel to Beringer et al. (2021), who found that Australian pregnant women's dietary intake was lower than the nationally recommended intake [10]. Morriset et al. (2016) revealed that pregnant women who have delivered outside Canada have a lower intake of iron and vitamin D than women who gave birth in Canada [11]. Ayesu et al. (2020) observed that some micronutrient intake of pregnant women in the Ashanti region of Ghana, namely iron, Zinc, and vitamin A were inadequate [12] Sukchan (2010) revealed that inadequate intake of protein and energy, as well as micronutrients in pregnant women in Thailand, the result is parallel with this study result. In parallel with

this result, Huybregts et al. (2009) found that the nutrition intake of pregnant women in Burkina Baso was inadequate [13, 14].

The pregnant women in this research were in the period of second and third trimesters of their pregnancy were included. The first trimester was excluded since the first trimester of pregnancy commonly has an eating disorder (hyperemesis). Huybregts (2009) found that nutrition intake was higher in the third trimester than first/second trimester. While Savard (2019) found that nutrition intake was stable throughout pregnancy. All nutritional requirement refers to the national RDA, except Copper refer to the RDA of the FDA [14–16].

Each nutrition has important in regulating the immune response. Vitamin C has a role in enhancing innate and adaptive immunity. Vitamin A regulates the activation of NK cells, regulates IL-2 and TNF α production., While vitamin E enhances the cytotoxic activity of NK cells, suppresses Th2, and encounters free radicals. Zinc has a role in the signaling pathways of non-specific and specific immunity. Copper maintains the normal function of NK cells, macrophages, and other immune cells and is also a radical scavenger in inflammation. Manganese maintains cellular signaling in the immune cell and acts as an antioxidant in moderate concentration [16].

Consumption of 205 mg/d vitamin C reduced the incidence of influenza, while the mean intake of the population was 128.008 mg. This intake can not protect pregnant women from respiratory infections. Vitamin A intake needed to encounter covid 19 was 2840 IU, while the population intake was 3646 IU. The Vitamin E intake of the population was 9.86 IU, while the vitamin E needed to prevent morbidity of covid 19 was 75 IU. Zinc intake was 4.6 mg, and Zinc needed to reduce the risk of infection was 5.7 mg [18–20].

5 Conclusion

Consumption of dietary antioxidants of the pregnant women population in the ASGM area met the RDA for vitamin A, vitamin C, Copper, and Manganese. The dietary antioxidant intake did not meet the minimum requirement for preventing viral infection and mercury intoxication for almost all vitamins and minerals except for vitamin A.

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