ORIGINAL ARTICLE

Factors Affecting Adherence of Multiple-micronutrient Supplement Consumption Among Pregnant Mothers in Surabaya, East Java, Indonesia

Annas Buanasita[1], Sri Sumarmi[2], Su Peng Loh[3], Kartika Sri Redjeki[4]

[1] Doctoral Program of Public Health, Faculty of Public Health, Universitas Airlangga, 60115 Mulyorejo, Surabaya, East Java, Indonesia
[2] Faculty of Public Health, Universitas Airlangga, 60115 Mulyorejo, Surabaya, East Java, Indonesia
[3] Department of Nutrition, Faculty of Medicine and Health Sciences, University Putra Malaysia, 43400 Serdang, Selangor, Malaysia
[4] Surabaya Health Office, Jl. Raya Jemursari 197 Surabaya, 60239 East Java, Indonesia

ABSTRACT

Introduction: Multiple micronutrient supplement (MMS) has proven to provide better pregnancy outcomes compared to Iron Folic Acid Supplement, including reducing the prevalence of low birth weight, premature births and infant mortality. Surabaya, a district in East Java Province, was among the first to pilot MMS for pregnant mothers. This study aimed to explore MMS adherence among pregnant mothers in Surabaya and identify factors affecting it. **Materials and methods:** A cross-sectional study with an explanatory design was conducted. The target population included all pregnant mothers attending 63 health centers across 5 areas of Surabaya in 2023. A sample size of 810 pregnant women was selected using cluster random sampling from all health centers. Data on respondents' characteristics, MMS adherence were collected through interviews in October 2023 using a structured, validated questionnaire administered by trained enumerators. Multiple logistic regression analysis was used to identify factors influencing MMS adherence. **Results:** More than half of the respondents were housewives, had a high school education level, had normal nutritional status, and were in the second trimester of pregnancy. The MMS acceptance rate was 81.5% with consumption adherence, namely those consuming according to gestational age 23.6%. Factors that influence adherence are employment status, pregnancy complaints, and gestational age with an OR of 0.436; 0.440; and 0.894 respectively. **Conclusion:** MMS adherence could be improved by providing educational promotion with an optimal personal approach by health workers in Surabaya.
Malaysian Journal of Medicine and Health Sciences (2025) 21(SUPP7): 124-133. doi:10.47836/mjmhs.21.s7.17

Keywords: Multiple micronutrient supplementation, Implementation, Pregnant women, Characteristics, Adherence

Corresponding Author:
Sri Sumarmi, PhD
Email: sri_sumarmi@fkm.unair.ac.id
Tel : +6281331319460

INTRODUCTION

The Iron and Folic Acid (IFA) supplementation program for pregnant women has been implemented by the Indonesian government since 1990 (1), but almost half of pregnant women in Indonesia are still anaemic (2). Some of the reasons anemia in pregnant women is still high in Indonesia are low adherence in IFA consumption for various reasons, and micronutrient deficiencies such as vitamin B1, B2, B3, B9, Zinc and Selenium not found in the IFA(3). Inadequate intake of micronutrients during pregnancy can lead to low birth weight (LBW), preterm birth, fetal malnutrition, or coexisting LBW and prematurity. The condition of micronutrient deficiency in the mother can also impair the growth and fetal development, resulting in neonatal stunting, immune system disorders, and changes in cardiometabolic function (4). Moreover the strategy for providing information regarding supplementation to pregnant women during pregnancy is still not optimal (5).

In 2020, WHO recommended the use of Multi Micronutrient Supplements (MMS) in guidelines for preventing anemia in research contexts (6), and in 2021 MMS has been included as an essential supplement to prevent anemia(7). After rigorous research, WHO recommends multiple micronutrient supplementation (MMS) instead of IFA as MMS has been shown to further reduce the risk of low birthweight. However, despite the MMS recommendation, Indonesia does not have a national regulation on MMS (4).

The Indonesian Nutrition Institute (INI) together with the Indonesian Ministry of Health, UNICEF, several universities, and stakeholders discussed the implementation of policies using MMS in Indonesia and the result showed more than 20 clinical trials from various countries showing that MMS had a positive impact on health, pregnant women and babies. Concequently, it was agreed that IFA would be replaced with MMS (8),(9). Multiple meta-analysis studies show that MMS containing 15 vitamins and minerals produces consistent relative risk reductions for several outcomes, including low birth weight, small-for-gestational-age births, preterm births and stillbirths, exceeding the benefits provided by IFA supplement(10).

The Indonesian Ministry of Health in collaboration with several universities are still making various preparations to shift the IFA program to MMS for pregnant women (7). The gradual shift of the IFA program towards a program providing MMS to pregnant women in Indonesia requires a strong innovation in improving the acceptance and adherence of MMS. Surabaya is the capital city of East Java Province which has ethnic, cultural, and socio-economic diversity, but the prevalence of anemia among pregnant mothers was still higher than the cut of WHO as a public health problem. In addition, the reduction of stunting prevalence in children was still low(11). Therefore, more research is needed to determine the factors that contribute to MMS adherence including in Surabaya.

MATERIALS AND METHODS

Study design

This study employed a cross-sectional survey design with a representative sample of pregnant mothers across Surabaya to assess the overall acceptability and adherence with MMS supplementation.

Population and Samples

The population of this study was all the pregnant mothers in Surabaya. Samples using cluster random sampling for each of the 5 regions in Surabaya namely Centre, East, West, North, and South Surabaya. Surabaya was chosen as the research location because Surabaya was one of the MMS pilot project in East Java. Mothers who were already pregnant and willing to be the respondents were eligible for this study. Samples were randomly selected 25-30 pregnant mothers in all sub- districts in each cluster. The study involved conducting 810 quantitative interviews with pregnant mothers across five regions of Surabaya.

Data Collection

Data on the characteristics of respondents were age, occupational status, education level, gestational age, pregnancy order, and frequency of ANC. All these variables were taken by interview. Maternal age is categorized into 2, namely normal age which does not have a high risk of pregnancy, and age which has a risk of pregnancy, that is under 20 years or over 35 years (12). The category of education is grouped into adequate is those who have graduated from Senior High School or above, and inadequate those who have a Junior High School education or below (13). The gestational age defined as the period since conception, calculated from the first day of the last menstruation to the day of the study, expressed in weeks.. For pregnancy orders, it is stated as the number of pregnancies the respondent had at the time of the interview. The frequency of ANC checks is expressed in units. Ideally, pregnant women should have their pregnancy checked at least 4 times during their pregnancy (14). The nutritional status of the respondents was also taken in this research by measuring the middle upper arms circumferences (MUAC). MUAC is a method for measuring the nutritional status of pregnant women, which is quite accurate and simple to determine the fat reserves of a pregnant woman. The MUAC tools used are a standard UAC type from UNICEF. If the MUAC is below 23.5 cm, the pregnant woman is declared to be at risk of protein-energy malnutrition (15).

In this study, MMS was distributed to all primary health centers in districts and subdistricts and delivered to pregnant women by health offices (midwives, doctors, nutritionists, and pharmacists). The MMS type was from WHO which is the United Nations International Multiple Micronutrient Antenatal Preparation (UNIMMAP). The composition of MMS compared to IFA and RDA (Recommended Dietary Allowance) for Indonesia's pregnant women is shown in Table I.

Table I: The comparison of MMS tablet and IFA tablet composition according to RDA for pregnant women

Nutrients	RDA for pregnant women	Micronutrients Composition	
		UNIMAPP MMS tablet	IFA tablet
Vitamin A (RE)	800	800	-
Vitamin D (µg)	5	5	-
Vitamin E (mg)	15	10	-
Vitamin K (mg)	15	-	-
Thiamin (mg)	1.3	1.4	
Riboflavin (mg)	1.4	1.4	
Niacin (mg)	17	18	
Folic Acid (µg)	600	400	400
Vitamin B6 (mg)	1.7	1.9	-
Vitamin B12 (µg)	2.6	2.6	-
Vitamin C (mg)	85	70	-
Calcium (mg)	950	-	-
Phosporus (mg)	600	-	-
Magnesium (mg)	270	-	-
Ferrum (mg)	35	30	60
Zinc (mg)	11.5	15	
Selenium (µg)	35	65	-
Manganese (mg)	2	-	-
Iodine (mg)	200	150	-

MMS data for pregnant women in this research were MMS acceptability, MMS adherence, and MMS information trusted source. MMS acceptability is defined as the mother's willingness to voluntarily accept and consume MMS supplements provided by health workers through the Community Health Center. One aspect of MMS acceptability is liking the color and packaging of the MMS. Meanwhile, MMS adherence is described by the number of MMS tablets consumed by the respondent according to the recommended age with a consumption frequency of 1 time per day or 90 tablets for 3 months of gestation and 180 tablets for 6 months of gestation, and so on (16). The pregnant women were asked, 'For how many days during this pregnancy did you take the MMS tablets?' Women who reported never receiving MMS during the pregnancy were coded as consuming 0 MMS tablets. Mothers who did not know whether they received MMS or Multi-micronutrient-containing tablets during the recalled pregnancy were excluded from the analysis. Women reporting a consumption of >240 MMS tablets during pregnancy were asked about when they got the MMS for the first time before pregnancy because Surabaya City had an MMS donation for those pre-married women. The questions included the identification of frequencies and MMS barriers. Sources of MMS-related information and methods of interest to respondents were also identified in this study. All the questionnaire in this study have validated and checked the reliability with Cronbach's alpha 0,849.

Data analysis

Descriptive analysis employed to describe the profile of the participants in the analysis. Bivariate logistic regression was employed to estimate the crude odds ratios, with a 95% confidence interval, for the association between the dichotomous outcome variable (mother's adherence to the MMS) and each of the explanatory factors without adjusting for other factors. All of the factors associated with the mother's complience in bivariate analyses (defined as $P \leq 0{\cdot}25$) were included in a multivariate logistic regression to identify those significantly associated with adherence. All variables will be analyzed by bivariate to know the differences in every region area of Surabaya by the Chi-Square Test. All statistical analysis was carried out using the statistical software package IBM SPSS Statistics for Windows, Version 20.0. This research has received approval from the Ethics of the Health Research Ethics Committee, Faculty of Dental Medicine, University of Airlangga No. 1183/HRECC.FODM/2023.

RESULTS

Characteristic of Respondents

The characteristics of respondents consist of maternal age, occupation status, education level, gestational age, pregnancy order, frequency of ANC, and nutritional status of pregnant mothers. There are no differences in terms of maternal age, occupational status, pregnancy order, frequency of ANC, and nutritional status is the 5 regions Surabaya. The detailed information can be seen in Table II.

Table II shows that the majority of mothers' ages during pregnancy are normal, between 20 and 35 years of age. However, 2.3% of mothers have a high-risk age of under 20 years, especially in the North Surabaya area. Meanwhile, the risk of pregnancy over 35 years is also quite large, namely 19.4%, with a relatively high proportion in the Central and South Surabaya areas. Almost 70% of mothers are housewives. The respondent's education was generally in the middle with more than 70 % of the women finishing primary education (had more than 9 years of schooling). The highest area with a low education level was North Surabaya with more than 30% having less than 9 years of schooling. The proportion of mothers who have gestational age in the second semester is slightly greater than those in the third trimester, and the lowest proportion is pregnant women in the first trimester. The results show that there were differences between gestational ages based on trimester in areas in the city of Surabaya. Most maternal pregnancy orders were multi-grande or in the second pregnancy, had more than 4 times ANC visits, and had normal nutritional status.

Table II: Respondent's Characteristics by Regions of Surabaya

Respondents Characteristic	Centre (n=125) (%)	East (n=204) (%)	West (n=197) (%)	North (n=93) (%)	South (n=191) (%)	Total (N=810) (%)	p
Maternal Age							
Normal	73.6	77.9	79.2	79.6	80.1	78.3	
Risk <20 years	4.8	1.0	2.5	5.4	0.5	2.3	0.101
Risk >35 years	21.6	21.1	18.3	15.1	19.4	19.4	
Occupation status							
Housewife	73.6	65.2	72.6	73.1	64.4	69.0	0.169
Working Mother	26.4	34.8	27.4	26.9	35.6	31.0	
Education Level							
>9 years of schooling	72.8	79.4	79.7	63.4	81.7	77.2	0.005*
≤9 years of schooling	27.2	20.6	20.3	36.6	18.3	22.8	

CONTINUE

Table II: Respondent's Characteristics by Regions of Surabaya (CONT.)

Respondents Characteristic	Centre (n=125) (%)	East (n=204) (%)	West (n=197) (%)	North (n=93) (%)	South (n=191) (%)	Total (N=810) (%)	p
Gestational age							
Mean ±SD (weeks)	25.0±8.5	24.6±8.1	22.6±8.7	23.6±9.9	24.3±8.7	24.0±8.7	0.082
Pregnancy Order							
Primigravida (first pre)	31.2	25.5	28.4	30.1	25.7	27.7	
Multigrande (second pre)	36.8	36.3	34.5	37.6	38.7	36.7	0.915
Grande multipara (≥4 pre)	13.6	12.7	15.2	14.0	13.6	12.8	
Frequency of ANC							
≥4 times	85.6	91.7	89.8	90.3	92.1	90.2	0.36
<4 times	14.4	8.3	10.2	9.7	7.9	9.8	
Nutritional Status (MUAC)							
PEM Risk (MUAC<23.5 cm)	20.0	21.6	22.3	30.1	24.6	23.2	0.443
Normal (MUAC≥23.5 cm)	80.0	78.4	77.7	69.9	75.4	76.8	

SD = Standart Deviation
ANC = Antenatal care
MUAC=middle upper arms circumference
PEM*= protein energy malnutriti
*Statistically significant different at p<0.05

MMS Acceptability and Adherence

MMS acceptability is defined as the mother's willingness to voluntarily accept and consume MMS supplements provided by health workers through the Community Health Center. Meanwhile, the number of supplements consumed during the first time got pregnancy until the time of the interview with a frequency of 1 x/day as a measure of respondents' level of MMS adherence.

Table III shows the acceptability of MMS was quite good with a percentage of more than 80%. The highest percentage was in the Centre of Surabaya and the lowest was in West Surabaya. There were no differences in the proportion of MMS acceptability across the Surabaya region. This indicates that MMS can be well received by pregnant women in the city of Surabaya. More than 90% of respondents liked the color and packaging of MMS. Table III also showed the level of adherence with MMS consumption as recommended, with total percentage of 23.6% based on the gestational age. The lowest percentage of MMS adherence was in the centre of Surabaya area.

Table III: MMS's Acceptability and Consumption by Regions of Surabaya

MMS Acceptance/Consumption	Centre (n=125) (%)	East (n=204) (%)	West (n=197) (%)	North (n=93) (%)	South (n=191) (%)	Total (N-810) (%)	p
MMS Acceptance							
Yes	88.8	78.9	77.2	79.6	84.8	81.5	0.052
MMS Preference							
Prefer the color	95.7	91.5	87.3	94.2	86.2	90.4	0.06*
Prefer the wrap	96.9	94.1	85.1	94.2	85.5	90.3	0.002*
First time Receiving MMS							
Before pregnant	1.6	1.0	5.1	8.6	3.7	3.6	0.009*
During pregnant	98.4	99.0	94.9	91.4	96.3	94.4	
MMS Adherence							
Yes according to gestational age	10.4	12.5	29.2	22.9	25.0	23.6	0.034*
No	89.6	87.5	70.8	77.1	75.0	76.4	
Freq MMS Consumption							
Seldom (1x/week)	9.9	17.4	24.3	18.9	15.4	17.4	
Sometime(2-4x/week)	16.2	12.5	15.8	9.5	19.1	15.4	0.053
Frequent (≥4x/week)	72.9	70.2	59.9	71.6	65.4	67.1	
MMS Barrier							
Difficult to open the bottle	27.0	53.4	45.4	41.9	45.1	43.8	
Forget	54.1	44.1	38.2	24.3	34.6	39.8	0.009*
Side effects (nausea)	7.2	12.4	15.1	13.5	12.3	12.3	
There are complaints	28.3	30.2	35.0	33.3	31.5	31.7	

*Statistically significant different at p<0.05

Figure 1 describes the percentage of MMS consumed by pregnant women respondents according to their gestational age. It can be seen that respondents from pregnant women in the second and third trimesters who should have consumed more than 90 MMS tablets have only met 80.1% of the MMS requirements for the second trimester and 67.9% for the third trimester. Meanwhile, those in the first trimester who should have consumed 90 tablets of MMS had achieved 89.3%.

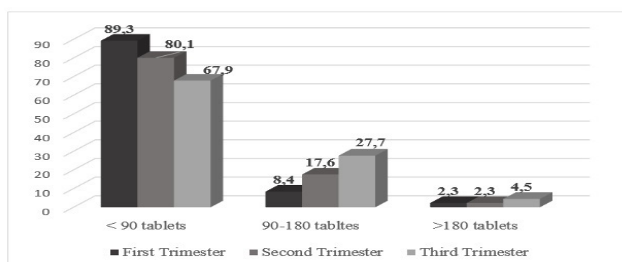

Figure 1: Consumption of Multiple Micronutrients Supplements (MMS) by Pregnant Mothers Across Trimester

The data shows that 4.5% of pregnant women who are in the third trimester (6-9 months of pregnancy) have consumed more than 180 tablets and pregnant women in first trimester pregnancies who have consumed more than 180 MMS tablets, is 2.3%. This shows that some respondents have consumed MMS even before becoming pregnant.

Table IV shows an overview of the distribution of sources information to respondents regarding MMS. Midwives are the first choice of source of information related to MMS which is trusted by pregnant women with a percentage of 81.7%, followed by doctors, pharmacists, nutritionists and cadres, close family, and finding out from browsing by themselves. About one-third of the pregnant women perceived having individual counseling as the chosen method for getting MMS information. This individual counseling was more common method of exposure to MMS information for the women than group meetings and social media.

Table IV: Sources of Trusted Information on Multiple Micronutrients Supplements (MMS) by Regions in Surabaya

MMS Info	West (n=125)	East (n=204	West (n=197)	North (n=93	South (n=191)	Total (N=810)	p
MMS Info Source							
Midwife	81.1	77.4	85.4	68.7	88.8	81.7	
Doctor	14.7	9.7	5.8	10.4	5.3	8.6	0.101
Nutritionist	1.1	5.8	2.2	1.5	1.3	2.6	
Pharmacists	0.0	2.6	2.9	10.4	2.6	3.1	
Cadres, browsing, family	3.2	4.5	3.7	9.0	2.0	4.0	
MMS Info Method							
Individual Counseling	34.2	34.2	27.6	24.3	32.1	31.1	
Group meeting	26.1	28.0	32.2	39.2	24.1	28.9	0.034*
Social media	24.3	24.2	24.3	17.6	31.5	25.3	

*Statistically significant at $p<0.05$

Analysis of Factors Affecting MMS Adherence

Table V shows the result of logistic regression analysis to determine the factors affecting MMS adherence. There are 3 significant variables, namely occupation status, pregnancy complaints status, and gestational age (OR= 0.894, CI 95% 0.861;0.928). First, occupational status affects the adherence to MMS (p value: 0.029) and working mothers were more likely to be adherence taking to MMS (OR=0.436, 95% CI 0.207;0.919). Secondly, pregnant mothers without pregnancy complaints more likely to be adherence to MMS compared those with pregnancy complaints (OR=0.440, 95% CI 0.237;0.817) and third, for every 1 week increase in gestational age, the probability of adherence to MMS consumption will increase to 0.894.

Table V: Factors Affecting MMS Consumption Adherence in Surabaya

Variables	B	p	Exp (B) OR	95% CI	
				Lower	Upper
Constant	0.193	0.660			
Occupations status					
Working mothers		0.029*	0.436	0.207	0.919
Housewife[R]			1.000	1.000	1.000
Pregnancy complaints status					
No pregnancy complaints		0.009*	0.440	0.237	0.817
Has pregnancy complaints[R]			1.000	1.000	1.000
Gestational age		0.000*	0.894	0.861	0.928

OR = odds ratio
CI = confidence interval
R = reference;
*Statistically significant at $p<0.05$

DISCUSSION

Respondents Characteristics

Most of the mothers are in the normal maternal age. Age during pregnancy often influences a women in making health and nutritional behavior decisions. Younger mothers are less aware of the importance of supplements during pregnancy, while older mothers may be more aware. Research by Husna, et.al (2021) shows that older mothers tend to have higher levels of adherence to iron supplements during pregnancy (17). This condition could be influenced by the capacity, available time and resources to make better choices in nutrition. On the other hand, Dairo and Lawoyin reported that mothers with a high risk of pregnancy are more likely not to comply with taking supplements compared to mothers at low risk of pregnancy (18).

According to Wiradnyani, et al, (2019) working mothers have a lower risk of being disobedient compared to mothers who do not work(19), because they have sufficient educational level. Mothers with higher levels of education tend to have greater knowledge about and adherence to supplement recommendations (20), (21). Even though the education level was high in 5 regions in Surabaya, but North Surabaya was the region with the highest proportion of low levels of education. Therefore family support as well as health provider support should be available in this condition. The phenomena were similar to a study by Melaku Desta, et.al, 2019 in Ethiopia which showed that the difference in the level of education gives different knowledge as well as the type of intervention later (22). Family support and health provider assistance were the keys to increase the pregnant mother's outcome to better pregnancy health (21),(19).

Most of the pregnant women in this study were in their second pregnancy (multigrade), although there was 12.8% in their fourth or more pregnancies (grand multipara). Having more than 4 pregnancies is a high-risk pregnancy, especially if the previous pregnancy interval was less than 36 months apart. A safe interval for a mother's next pregnancy is 36 months (23). Every pregnant woman is encouraged to have her pregnancy checked at least 4-6 times during pregnancy. Based on the results of the research above, it was found that the majority of respondents having a pregnancy check frequency was more than 4 times and the percentage was evenly distributed throughout the city of Surabaya.

The majority of pregnant women in this study had normal nutritional status based on MUAC, but 23.2% of them were at risk of protein energy malnutrition (PEM). During antenatal care, all pregnant mothers got services such as measurements of weight and middle-upper arms circumference (MUAC) to know their nutrition status. They also get measurements of fundal height, blood pressure, and hemoglobin levels to know the risk of anemia and provide micronutrient supplementation and education. The study showed that the highest prevalence of mothers who had a risk of PEM was in North Surabaya region with 30.1%. A pregnant mother who had PEM will increase the risk of having a baby with a body weight or body length below normal (less than -2.00 SD), and if in the future it is not optimized with basic nutrition and health services in the first 1000 days of the baby's life, will increase the risk of children becoming stunted when they are toddlers (24). This finding is in correlation with the situation in Indonesia. Between 2013 and 2020, the Ministry of Health Republic Indonesia reported that the prevalence of undernutrition during pregnancy decreased from 24 to 10 percent. Despite this, discrepancies were still present in many regions, with some reporting as high as 37 percent (11). In comparison to older pregnant women, pregnant women between the ages of 15 and 19 also have a significantly greater rate of undernutrition (34% nationwide). Therefore, supplemental feeding should be provided, in addition to micronutrients supplementary, nutrition education and counseling (2),(25).

MMS Acceptability and Adherence

The research findings shows that MMS acceptability was high, but the adherence was still low. This is in line with the findings of research conducted by Abidah and Sumarmi (2024) regarding MMS adherence compared to IFA adherence at one of the Community Health Centers in the East Surabaya regions, the finding shows that those who were truly compliant consumed MMS a day according to gestational age is 20.8%, which is the same percentage as full IFA adherence. However, in the study, it was discovered that respondents who complied with 80% of the MMS tablets given were much higher in the group of respondents from pregnant women who received MMS than pregnant women who received IFA. This means that MMS can be accepted and complied with by pregnant women when consuming it (16). A systematic review conducted by Melaku Desta, et, al (2019) in Ethiopia showed a similar thing with the low level of adherence among pregnant women due to several barriers, namely fear of side effects and forgetting to consume it, with a percentage approaching 50% (22).

The result showed that the majority of respondents received MMS well. More than 75% of respondents were used to consume MMS more than 4 times a week, but they would not consume it every day, because of being forget and having difficulty in opening the MMS bottle cap. This indicate that there is a need for intervention to provide explanations and demonstrations regarding how to open MMS bottle caps. The results of a systematic review conducted by Gomes, F, et.al (2021) regarding all study interventions to increase adherence to micronutrient supplementation during pregnancy with a randomized controlled trial design showed implementing an education-based intervention to increase adherence to MMS consumption with a personal approach. Apart

from that, interventions that are proven to be able to increase MMS adherence are using monitoring cards, and SMS reminders and consumption monitoring with a strong supporting system (6). Increasing family support, knowledge and perceived benefit of supplements to mothers were the actions to be taken by health workers to improve adherence (6),(19),(22) .

Pregnant mothers in the first trimester who should have consumed 90 tablets of MMS achieved 89.3%. It exceeded the data on IFA consumption among pregnant women in Indonesia by 35.2% in 2018 (15). There was only 12.3% of respondents who did not comply with consuming MMS because it had side effects such as nausea. Nausea occurs naturally in almost all pregnant women, due to hormonal changes, especially at the beginning of their pregnancy. However, nausea as a side effect of MMS is smaller compared to IFA tablets. Fe composition is lesser in MMS compared to IFA, and the vitamin B6 content in MMS could reduce nausea in pregnant women (26) (27) (28).

Midwives are the first choice of information source related to MMS by pregnant women (81.7%), followed by doctors, pharmacists, nutritionists and cadres, close family, and finding out from browsing by themselves. What is interesting is that the level of trust in midwives in North Surabaya, where the majority of the population is ethnically Madurese, it turns out that is not as high as in other areas of Surabaya. Apart from doctors and pharmacists they trust, they also choose close family, health volunteers, and themselves to browse for information regarding this supplement. This is in line with the results of research conducted by Frederick, et.al (2022) with the study about the existing barriers and enablers to uptake and adherence of supplement use during pregnancy in Haiti, which states that apart from health workers, information is trusted regarding supplementation in pregnant women are healthy volunteers and relatives or closed family (29). Likewise, research conducted by Elsharkawy N.B, et.al (2022) showed that the Health Information Package Program intervention by health workers was able to increase the level of knowledge and adherence with supplement consumption among respondents (30). These findings can certainly suggest that the implementation of an education program from health workers and consumption monitoring measurement, which involves the supervision of supplement consumption by volunteer health workers or family members, has demonstrated efficacy in enhancing adherence to supplementing. Health workers were to be the one resource of MMS information that could improve the intention of pregnant mothers in consuming the supplements, including MMS in their antenatal care visit(31),(32),(33).

Analysis of Factors Affecting MMS Adherence

This finding is almost the same as a study conducted by Sabaria in Pare-Pare, Sulawesi (2023) which found that the factors that influence pregnant women's adherence in consuming MMS are maternal age, gestational age, pregnancy interval, side effects, and health insurance (32).

Our study findings indicate that working pregnant mothers more likely to comply with MMS consumption compared to those who do not work. These findings were in line with the existing literature. First, employment status is frequently linked to higher levels of education and health literacy. Working mothers might have better knowledge about the benefits of MMS and the risks associated with micronutrient deficiencies during pregnancy. Educated mothers are more likely to understand medical advice and the importance of adherence to supplementation (22). Working mothers often have more structured daily routines compared to non-working mothers. A fixed schedule can contribute to better adherence to MMS, as taking supplements can become a part of their daily routine. Regular working hours can act as a reminder and help establish a habit of taking MMS consistently. Third, work environments can provide social support and peer influence, encouraging positive health behaviours. Colleagues and workplace health programs may offer additional reminders and motivation for pregnant mothers to take their supplements regularly (6).

Meanwhile, pregnant mothers without pregnancy complaints more likely to be adherence to MMS compared those with pregnancy complaints. Common pregnancy complaints such as nausea and vomiting (morning sickness) could be significantly hinder adherence with supplements both IFA and MMS. These symptoms can make swallowing pills difficult and lead to aversions to taking supplements, as they might exacerbate feelings of nausea or result in vomiting shortly after ingestion, reducing the perceived benefit of taking them (23). However, it needs further investigation concering these symptoms with MMS intake, whether mothers might avoid taking supplements to prevent her perceived or real side effects.

The study findings indicate that for every one-week increase in gestational age, the probability of complying with MMS consumption decreases to 0.894. The potential reasons behind this trend could be 1) Early pregnancy motivation, 2) Decreased symptoms in later pregnancy, 3) Increased awareness in their health and nutrition and 4) Preparing for baby healthy birth. As pregnancy progresses, some early symptoms such as nausea and vomiting may subside, making it easier for mothers to continue or improve their adherence with MMS as long as their motivation and awareness to give birth healthy increase (30). There is a need to develop behavior change strategies to increase uptake and adherence to maternal supplementation, especially MMS (34).

Strengths and Limitations of The Study

The strength of this study showed the importance of occupational status, pregnancy complaints, and gestation age as factors associated with MMS adherence. However, amog that factors, pregnancy complaints, is less explored in previous studies. The limitation did not include other potential confounding factors, like socioeconomic status and pre-existing knowledge about supplementato, which could influence to MMS adherence. Additionally, sampling bias related to gestational age, could skew the adherence because of the varying symptoms during pregnancy. Controlling for these factors, would improve the accuracy of the findings.

CONCLUSION

In conclusion, this study underscores the significant acceptance of multiple micronutrient supplementation (MMS) among pregnant mothers in Surabaya. Despite this positive reception, actual adherence—defined as consumption according to gestational age—needs tobe increased. The research identified key factors influencing adherence, including employment status, pregnancy-related complaints, and gestational age. These findings highlight the need for targeted educational interventions that leverage trusted health workers to enhance adherence rates.

ACKNOWLEDGEMENT

Researchers would like to thank the Surabaya Health Office , the Airlangga Partnership and Development Management Board, Vitamin Angels, all Community Health Center officers throughout Surabaya City, and all pregnant women respondents who have helped and participated in this activity.

REFERENCES

1. Thaha, A.R., Hadju, V., Dachlan, D.M., Jafar, N., Hidayanti, H., Salam, A., Amir, S.,Hasan, N., Novrian, A., Hasan, M., Harvey, Q., Santika, O., Hurley, K, 2022. Pregnant Women's Experience with Multiple Micronutrient Supplement (MMS): Qualitative Research from Three Districts in Indonesia. Current Developments in Nutrition, 6(1): pp. 705. DOI:10.1093/cdn/nzac061.089.
2. World Bank. Moving Forward : How Indonesia Districts reduce Stunting. 2021; © Washington, DC. http://hdl.handle.net/10986/37476 License: CCBY 3.0 IGO.".
3. Haider BA, Bhutta ZA. Multiple-micronutrient supplementation for women during pregnancy. Update of Cochrane Database Syst Rev. 2006;(4):CD004905; PMID: 17054223]. Cochrane database Syst Rev [Internet]. 2017;11(4):14. Available from: http://ovidsp.ovid.com/ovidweb.WS=N&PAGE=fulltext&D=med7&AN=23152228 doi: 10.1002/14651858.CD004905.pub5.
4. Sumarmi, S. Wiryatmadi, B, Kuntoro, Gumilar, E., Adriani, M., Retnowati., E, . (2015) 'Micronutrients supplementation during preconception period improves fetal survival and cord blood Insulin-Like Growth Factor 1', Asian Journal of Clinical Nutrition, 7(2), pp. 33–44. Available at: https://doi.org/10.3923/ajcn.2015.33.44
5. WHO. WHO antenatal care recommendations for a positive pregnancy experience Nutritional interventions update: Multiple micronutrient supplements during pregnancy. 2008. 282 p. https://www.who.int/publications/i/item/9789241549912 ISBN: 9789241549912 WHO Reference Number: WHO/RHR/16.12
6. Gomes, F., Agustina, R., Black, R. E., Christian, P., Dewey, K. G., Kraemer, K., Shankar, A. H., Smith, E., Tumilowicz, A., & Bourassa, M. W. (2022). Effect of multiple micronutrient supplements vs iron and folic acid supplements onneonatal mortality: a reanalysis by iron dose. Public health nutrition. https://doi.org/10.1017/S1368980022001008
7. MMS TAG and IGI 2021. Policy Brief 1 Manfaat Tambahan Multiple Micronutrient Supplements (MMS) bagi Ibu Hamil dibandingkan dengan Suplementasi Zat Besi dan Asam Folat (Tablet Tambah Darah) Policy Brief 1 Sudah saatnya Indonesia melangkah maju dengan kebijakan suplementasi. 2021;1–4. https://vitaminangels.org/wpcontent/uploads/2023/01/IND_MMS-Facts-for-Service-Providers_042621-1.pdf
8. United Nations 2020. Expert consensus on an open-access United Nations International Multiple Micronutrient Antenatal Preparation–multiple micronutrient supplement product specification. Ann N Y Acad Sci. 2020;1470(1):3–13. doi: 10.1111/nyas.14322. Epub 2020 Mar 9.
9. Micronutrient Forum and HMHB. Interim Guidance for Concurrent Antenatal Multiple Micronutrient Supplementation and Anemia Treatment in Pregnant Women. 2023;(October):1–10. https://hmhbconsortium.org/knowledgehub/interim-guidance-for-concurrent-antenatalmultiple-micronutrient-supplementation-andanemia-treatment-in-pregnant-women/
10. Kraemer K, Olson, Rebecca HK. Focusing on Multiple Micronutrient Supplements in Pregnancy: Second Edition. 2nd ed. Sight and Life Foundation Basel, Switzerland ISBN 978-3-9525058-6-1; 2023.
11. Indonesia MoH. Survey Status Gizi Indonesia (SSGI) Tahun 2021. Vol. 2, Buana Ilmu. 2021. https://www.badankebijakan.kemkes.go.id/buku-saku-hasil-studi-status-gizi-indonesia-ssgitahun-2021/.
12. Keats EC, Haider BA, Tam E, Bhutta ZA. Multiple-micronutrient supplementation for women during pregnancy. Cochrane Database Syst Rev. 2019;2019(3) doi: 10.1002/14651858.CD004905.pub6.

13. Shodikin AA, Mutalazimah M, Muwakhidah M, Mardiyati NL. Tingkat Pendidikan Ibu Dan Pola Asuh Gizi Hubungannya Dengan Kejadian Stunting Pada Balita Usia 24-59 Bulan. J Nutr Coll. 2023;12(1):33–41 available at https://ejournal3.undip.ac.id/index.php/jnc/article/viewFile/35322/28769.
14. Chandra F, Junita DD, Fatmawati TY. Tingkat Pendidikan dan Pengetahuan Ibu Hamil dengan Status Anemia. J Ilm Ilmu Keperawatan Indones. 2019;9(04):653–9 DOI:10.33221/jiiki.v9i04.39815. Indonesian Health Ministry. Indonesia Basic Health Reserach 2018. 53(9):1689–99. Available from: https://kesmas.kemkes.go.id/assets/upload/dir_519d41d8cd98f00/files/Hasil-riskesdas-2018_1274.pdf
16. Abidah N, Sumarmi S. A Comparison of Adherence Levels of Pregnant Women to Consuming Multiple Micronutrient Supplements and Iron Folic Acid at Mulyorejo Public Health Center, Surabaya. Amerta Nutr. 2024;8(1):17–25 https://doi.org/10.20473/amnt.v8i1.2024.17-25.
17. Husna F, Aldika Akbar MI, Amalia RB. Komplikasi Kehamilan Dan Persalinan Pada Kehamilan Remaja. Indones Midwifery Heal Sci J. 2021;3(2):138–47. https://doi.org/10.20473/imhsj.v3i2.2019.138-147
18. Dairo MD, Lawoyin TO. Demographic factors determining adherence to iron supplementation in pregnancy in Oyo State, Nigeria. Niger J Med. 2006;15(3):241–4. doi: 10.4314/njm.v15i3.37221.
19. Wiradnyani LAA, Khusun H, Achadi EL, Ocviyanti D, Shankar AH. Role of family support and women's knowledge on pregnancy-related risks in adherence to maternal iron-folic acid supplementation in Indonesia. Public Health Nutr. 2016;19(15):2818–28. DOI: 10.1017/S1368980016001002
20. Nabila N, Adriani, H 2023. Determinan Kepatuhan Minum Tablet Tambah Darah (Ttd) Pada Ibu Hamil. 2020;13(July):1–23. https://journal.unigres.ac.id/index.php/JNC/article/view/2810/2093
21. Purnasari G, Briawan D, Dwiriani CM. Kepatuhan Konsumsi Suplemen Kalsium Serta Hubungannya Dengan Tingkat Kecukupan Kalsium Pada Ibu Hamil Di Kabupaten Jember. J Kesehat Reproduksi. 2016;7(2):83–93. http://dx.doi.org/10.22435/kespro.v7i2.4968.83-93
22. Desta M, Kassie B, Chanie H, Mulugeta H, Yirga T, Temesgen H, et al. Adherence of iron and folic acid supplementation and determinants among pregnant women in Ethiopia: A systematic review and meta-analysis. Reprod Health. 2019;16(1):1–14. doi:10.1186/s12978-019-0848-9
23. Indonesia MoH. Modul pelatihan pelatih konseling pemberian makan bayi dan anak (pmba) kementerian kesehatan republik indonesia. English Lang Teach [Internet]. 2022;39(1):1–24. http://dx.doi.org/10.1038/nature21059%
24. Indonesian Government. Presidential Decree of Republic Indonesia No 72/2021 about Accelerating Stunting Reduction. Indones Gov. 2021;(1):23. https://peraturan.bpk.go.id/Details/174964/perpresno-72-tahun-2021
25. Jaisamrarn U, Esteban-Habana MA, Padolina CS, Decena DCD, Dee MT, Damodaran P, et al. Vitamins and minerals, education, and self-care need during preconception to 1000 days of life in Southeast Asia: An expert panel opinion. SAGE Open Med. 2023;11. doi: 10.1177/20503121231173377
26. UNICEF, World Health Organization, United Nations University. Composition of a multi-micronutrient supplement to be used in pilot programmes among pregnant women in developing countries: report of a United Nations Children's Fund (UNICEF), 1999; https://pmc.ncbi.nlm.nih.gov/articles/PMC6478115/
27. Rumiris D, Purwosunu Y, Wibowo N, Farina A, Sekizawa A. Lower rate of preeclampsia after antioxidant supplementation in pregnant women with low antioxidant status. Hypertens Pregnancy. 2006;25(3):241–53. doi: 10.1080/10641950600913016.
28. Schulze KJ, Mehra S, Shaikh S, Ali H, Shamim AA, Wu LSF, et al. Antenatal multiple micronutrient supplementation compared to iron-folic acid affects micronutrient status but does not eliminate deficiencies in a randomized controlled trial among pregnant women of rural Bangladesh. J Nutr. 2019;149(7):1260–70. doi: 10.1093/jn/nxz046.
29. Frederick J, Ajello C, Marhone J. Adherence of Supplements for Pregnant Women in Haiti. Curr Dev Nutr [Internet]. 2022;4:852. Available from: https://doi.org/10.1093/cdn/nzaa053_057
30. Elsharkawy NB, Abdelaziz EM, Ouda MM, Oraby FA. Effectiveness of Health Information Package Program on Knowledge and Adherence among Pregnant Women with Anemia: A Randomized Controlled Trial. Int J Environ Res Public Health. 2022;19(5). doi: 10.3390/ijerph19052724.
31. Unicef. Maternal Nutrition in Indonesiua : Landscape Analysis and Recommendations. 1st ed. Jakarta: Unicef Indonesia; 2023. 1–69 p. https://www.unicef.org/indonesia/media/19111/file/Maternal%20nutrition%20in%20Indonesia.pdf
32. Battung SM, Beek EM Van Der, Groen H. Implementation of multiple micronutrient supplementation in the Parepare district , Indonesia ; Population characteristics and intake

adherence . 2024, https://doi.org/10.21203/rs.3.rs-4319563/v1
33. Kemenkes RI. Workshop Multi Micronutrient Supplementation (MMS) Sebagai Suplementasi Untuk Ibu Hamil di Indonesia. 2023;1–10. https://kemkes.go.id/eng/menkes-tekankanpentingnya-ragam-mikronutrien-bagi-ibu-hamil
34. Indonesia Suplementasi Multiple- Micronutrient untuk Ibu Hamil MMS-UNIMMAP Formulation.: MMS in Indonesia: progress of Implementation. 2022. https://vitaminangels.org/wpcontent/uploads/2023/01/IND_MMS-Facts-for-Service-Providers_042621-1.pdf