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Original Article

Micronutrient supplementation among pregnant women in western Algeria

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Abstract

Background: Although micronutrient supplementation is a frequent practice during pregnancy, it remains poorly documented, particularly in Algeria. **Aims**: Our objective was to assess the prevalence and factors associated with the use of micronutrient supplements among pregnant women. **Subjects and Methods:** The data of the present study were obtained from a cross-sectional survey conducted through a questionnaire among 384 pregnant women receiving prenatal care at a major mother and child specialized hospital in Sidi-Bel-Abbes city (Algeria). **Results:** This study showed that 83.1% of pregnant women were taking micronutrient supplements. Among these women, 70,8% were taking a multi-supplementation. The two most frequently reported micronutrients were: iron (77.9%) and folic acid (77.3%). The highest rates of supplementation were recorded in the third trimester. Other common supplements used were: magnesium, iodine, vitamin D, vitamin C, omega 3, and calcium (46.4%, 38.8% 36.5%, 34.6%, 27.3%, and 21.4% respectively). It appears that these products were mainly dispensed in pharmacies under medical prescription. The variables significantly associated with their use were: Education level, pregnancy age, parity, pre-conception consultation, urbanicity, and physical activity. **Conclusions**: Collecting these types of data is essential not only to document micronutrient supplement intake, but also to help implement awareness campaigns about their use during pregnancy and whether they are necessary to ensure adequate micronutrient intake.

Keywords: Micronutrients, supplementation, Pregnancy, Algeria.

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1 Introduction

Micronutrient deficiencies are a common issue among women of reproductive age (15 to 49 years of age), especially those residing in low- and middle-income countries where dietary diversity is low and fortification programs are not implemented [1]. Micronutrient deficiencies are exacerbated during pregnancy due to increased requirements of the growing fetus, placenta, and maternal tissues. An inability to fulfill the increased demands results in potentially adverse effects on the mother and the fetus[2].

The fight against vitamin and mineral deficiencies is, therefore, an essential part of the general effort to fight malnutrition, especially in the most special cases such as vegetarian and vegan women or women with multiple pregnancies. Increasing micronutrient status can involve a number of approaches like increasing dietary intake of micronutrient-rich foods, food fortification, and supplementation.

Supplementation is the provision of relative micronutrients in high doses, usually in the form of tablets, capsules, or syrup. Supplementation has the advantage of being able to provide an optimal amount of one or multiple nutrients in a form that is highly assimilated by the body and is often the faster way to fight against a deficiency condition in individuals or population deficient groups [3].

The curative and preventive importance of supplementation is an important subject in the life of a couple as soon as they wish to have a child. The question of supplementation during pregnancy could help to improve the health of both mother and baby. However, the supplementation of pregnant women must take into account their diet, which of course depends on their cultural tastes and habits, but also on the socio-economic level of each patient [4].

Aside from the obvious deficiencies, only a few supplements can be discussed. Systematic vitamin D supplementation is recommended in areas with low levels of sunlight. Folate supplementation is desirable in the pre-conception phase and during the first trimester in case of risk of neural tube closure anomaly. Iron supplementation should be supported by anemia or hypoferritinemia. Iodine supplementation is recommended in areas of iodine subdeficiency [5].

Several studies conducted in recent years have questioned the effectiveness of vitamin and mineral supplements. Doses that are too high could even cause long-term health damage. The fact that vitamins are considered harmless and beneficial in the population can lead to self-supplementation behavior and doctors and pregnant women should be alerted to the potential risk of excessive supplementation [6].

Internationally, micronutrient supplementation of pregnant women has been the subject of several studies, especially in recent decades. However, in Algeria, this subject remains very

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poorly documented. In this context, we conducted a descriptive study among pregnant women in Sidi-Bel-Abbes city in order to assess the extent of this phenomenon, firstly by estimating the prevalence of micronutrient supplementation among these women, then by identifying the factors associated with it (socio-demographic factors, lifestyle, health status, etc.).

2 Subjects and Methods

2.5 Study design and participants

In this cross-sectional study 400 women in their first, second, or third trimester of pregnancy were recruited, 384 consented and completed the questionnaire. The participants were recruited from a major Mother-child specialized hospital of Sidi-Bel-Abbes city (western Algeria), between October 2019 and January 2020. The pregnancy was initially confirmed by ultrasound, urine, or blood beta-human chorionic gonadotropin "βHCG". Gestational age was calculated based on the date of the last menstrual period and ultrasound fetal biometrics performed by the attending obstetricians [7].

Pregnant women who were younger than 18 years were excluded. The informed consent has been obtained from all participants.

2.5 Data collection

All the information collected was obtained through face-to-face interviews. The interview covered different aspects of pregnancy including general information, socio-demographic, lifestyle, and health characteristics: age, residency, occupation, educational level, parity, pregnancy age, health problems, medication consumption, and physical activity. Regarding the supplements use, both regular and medicinal micronutrient supplements were considered in this study. Participants were asked if they were currently taking any micronutrient supplements (at least 3 days a week). The participants were asked to specify the type of micronutrient using a list of 18 different micronutrients (13 vitamins, 5 minerals and trace elements in addition to omega 3) referring to the nutritional information on the packaging of the dietary supplement that they were currently taking. Circumstances of micronutrient supplements purchase (prescription versus self-supplementation) were also reported.

In the first instance, a pilot study of 20 pregnant women was performed to confirm the reliability and the validity of the questionnaire. Content and face validity were done by health professionals and physicians. In order to guarantee the reliability of the test, the expert's suggestions and opinions have been considered.

2.5 Statistical analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS) 22.0. Quantitative variables were expressed as means ± standard deviation (SD) and qualitative variables as percentages. Pearson Chi-square test was used to examine differences involving categorical variables. The difference is considered significant if the *p-value* is less than 0.05.

3 Results

3.1 Demographics

The minimum and maximum age of the patients were 18 and 46 years, respectively, with a mean age ± standard deviation (SD) of 30,3 ± 6,2 years. Regarding the pre-pregnancy body mass index, approximately half of these women had a normal BMI (BMI between 18,5 and 24,9) while the other half were either over weighted or obese (Table 1). Among these women: 11.2% were in the first trimester of pregnancy, 10.7% in the second trimester and 77.9% in the third trimester of pregnancy. Nearly 75 % of them were healthy. Some particular health problems were reported: anemia 4.4 %, high blood pressure 6.8 %, diabetes 7.3%, and dysthyroidism 4.4%. A large part of patients (54.4%) had a moderate to intense physical activity (Table 1). About 13% of the interviewed women had an elementary school level while 87% of them had an intermediate or higher educational level. Most of these women were jobless and lived in urban areas (Table 1).

3.2 Prevalence of supplementation

The prevalence of micronutrient supplementation among surveyed pregnant women was 83.1% (Table 2). Among these women, 70.8% were taking multiple supplements. About two-thirds of these women were taking this supplement daily.

3.3 Global and specific micronutrients supplementation according to the trimester of pregnancy

Table 2 shows that the highest supplementation rate was recorded in the 3rd trimester (87.7%) with a significant difference between the three trimesters. The two most frequently reported micronutrients were iron and folic acid. The proportion of female iron users tripled in the third trimester compared to the first trimester to reach 83%. About two-thirds of women took folic acid in the first trimester and this consumption increased to over 80% in the third trimester. Regarding magnesium, more than 40% of women took it regardless of the trimester of pregnancy. The proportion of pregnant women who took supplements containing iodine reached 43.9% during the second trimester. Calcium supplements were used by about 5% of women in the first two trimesters but this rate was multiplied by 5 during the third trimester. The vitamin B6 intake rate was on average 45.1%. Regarding vitamins: B1, B2, B5, B8, B12, D, C, E, and omega 3, their intake rates varied between: 27% to 37%. The micronutrients less consumed as supplements were vitamin A, vitamin B3, and zinc (3 to 16%).

3.4 Circumstances of micronutrient supplements purchase

According to Figure1 data, 94% of supplements used by pregnant women were prescribed by a gynecologist, 5% were advised by a pharmacist and around 1% of them were taken as self-supplementation.

Table 1: Use of micronutrient supplements during pregnancy based on Sociodemographic, lifestyle, and health Characteristics

Parameters		All pregnant Women (n = 384)		Supplement users (n = 319)		Supplement nonusers (n = 65)		*p value*
		n	(%)	n	(%)	n	(%)	
Age (years)	< 25	78	20.3	70	22.0	8	12.3	0.078
	⩾ 25	306	79.7	249	78.0	57	87.7	
Pre-pregnancy BMI Category (kg/m²)	Under weight: BMI < 18,5	1	0.2	1	0.3	0	0	0.441
	Normal: 18,5 ≤ BMI ≤24,9	198	51.6	178	55.8	20	30.8	
	Overweight: 25 ≤BMI ≤29,9	102	26.6	73	22.9	29	44.6	
	Obese: BMI ≥ 30	83	21.6	67	21.0	16	24.6	
Parity	Primiparity	131	34.1	118	37.0	13	20.0	<0.001
	Multiparity	253	65.9	201	63.0	52	80.0	
Trimester of pregnancy	1st Trimester	43	11.2	29	9.1	14	21.5	<0.001
	2nd Trimester	41	10.7	27	8.5	14	21.5	
	3rd Trimester	300	78.1	263	82.4	37	57.0	
Professional Status	Employee	63	16.4	57	17.9	6	9.2	0.087
	Housewife	321	83.6	262	82.1	59	90.8	
Educational Level	Elementary	50	13.0	32	10.0	18	27.7	<0.001
	Intermediate	131	34.1	104	32.6	27	41.5	
	Secondary	132	34.4	118	37.0	14	21.5	
	Bachelor 's degree or higher	71	18.5	65	20.4	6	9.3	
Urbanicity	Rural	110	28.6	76	23.8	34	52.3	<0.001
	Urban	274	71.4	243	76.2	31	47.7	
Pre-conception consultation	Yes	353	91.9	302	94.7	51	78.5	<0.001
	No	31	8.1	17	5.3	14	21.5	
Health status	Healthy	255	66.4	240	75.2	15	23.1	0.773
	Unhealthy	129	33.6	79	24.8	50	76.9	
Medication intake	Yes	85	22.1	73	22.9	12	18.5	0.434
	No	299	77.9	246	77.1	53	81.5	
Physical activity	Low	175	45.6	132	41.4	43	66.1	<0.001
	Moderate to intense	209	54.4	187	58.6	22	33.9	

Body mass index (BMI) categories according to the WHO classification [8]

3.5 Reasons for not utilizing micronutrient supplements

About 17% of the women said that they do not take any supplements. The main reasons mentioned are represented in Figure 2.

4 Discussion

The study revealed that 83.1% of pregnant women were supplemented with micronutrients. This high rate is also found in some middle income or even high-income countries: 96,8% in Jordan [9], 88% in Egypt [10], 71.5 % in Saudi Arabia [11], 78% in the United States of America[12], 81% in Norway [13], 85 % in Finland[14].

Seven in ten women were taking multi-micronutrient supplements (Versus six in ten women in Jordan [15]). It is known that multiple micronutrient deficiencies can often coexist in pregnant women due to the increased needs during pregnancy, especially in developing countries. In this regard, women are usually multi-supplemented early in pregnancy with a combination of different vitamins and minerals in a single supplement, making this approach more effective and convenient. However, no consensus has been reached on replacing iron and folic acid supplementation with multi-supplementation. Although, the positive effects of multi-supplementation during pregnancy have been demonstrated by several studies, it is

controversial, especially with regard to its safety and long-term effects.

Recently, a systematic review was published by *Keats et al.* [16] which aimed to evaluate the benefits of oral multi-micronutrient supplementation during pregnancy on maternal, fetal, and child health. Most of the studies included in the analyses were conducted in low- and middle-income countries. The results support the effect of multi-micronutrient supplements with iron and folic acid in improving some pregnancy outcomes. Overall, pregnant women who received multi-micronutrient supplementation had fewer low birth weight babies and smaller babies for gestational age. In addition, multi-micronutrient supplementation probably reduces premature births; no significant benefits or harms of multi-micronutrient supplementation were found for mortality outcomes (stillbirths, perinatal, and neonatal mortality). These results can provide a basis for guiding the replacement of iron and folic acid supplements with multi-micronutrient supplements for pregnant women living in low- and middle-income countries [16].

However, in the same review, safety was assessed only on the basis of perinatal health (e.g., premature births, maternal and neonatal mortality, congenital anomalies, etc.), while long-term health could not be studied. It may therefore be premature to claim the safety of relatively high doses of micronutrients through supplementation. Moreover, the accumulation of different sources of vitamins and minerals without regular biological monitoring among pregnant women can lead to harmful consequences spatially in the absence of established needs.

On the other hand, this study revealed that the two most frequently reported micronutrients were iron (77.9%) and folic acid (77.3%). Some reports in the same region of MENA (The Middle East and North Africa) showed also that the majority of pregnant women were taking these two supplements in: Jordan [14], Egypt [17], Tunisia [18].

According to the WHO, daily oral iron and folic acid supplementation, with 30-60 mg of elemental iron and 400 µg (0.4 mg) of folic acid, is recommended for pregnant women to prevent maternal anemia, puerperal sepsis, low birth weight and preterm births [19]. A prevalence of 46.86% of anemia was reported among pregnant women in Sidi-Bel-Abbes city [20].

The rate of calcium intake in our population was 21.4% (Table 2) at daily doses of 500 to 1000 mg. Compared to other countries in the same geographical zone (MENA), the United Arab Emirates reported a similar rate of 28.6% [21] but in Jordan the rate seems to be higher (67%) [9]. Pouchieu *et al.* [22] in the French NutriNet-Santé cohort study found also a low calcium intake rate.

In populations where dietary calcium intake is low, daily supplementation (1.5-2.0 g of elemental calcium orally) is recommended by WHO for pregnant women to reduce the risk of pre-eclampsia [19].

Limited data on calcium supplementation at lower doses suggest a reduction in pre-eclampsia, hypertension, and admission to neonatal intensive care [23], but this needs to be confirmed by larger, high-quality trials.

Zinc supplements were used by 15.9% of the pregnant women in this study (Table 2). Our results are similar to Pouchieu *et al.* [22].

The evidence for a 14% relative reduction in preterm birth for zinc compared with placebo was primarily represented by trials involving women of low income and this has some relevance in areas of high perinatal mortality. There was no convincing evidence that zinc supplementation during pregnancy leads to other useful and important benefits [24].

Furthermore, this study showed that magnesium supplementation was around 46.4% (Table 2). This finding converges with some reports [22, 25]. A systematic review aimed to assess the effects of magnesium supplementation during pregnancy on maternal, neonatal, and pediatric outcomes concluded that there is not enough high-quality evidence to show that dietary magnesium supplementation during pregnancy is beneficial [26].

In this study, the uptake rate for iodine supplementation was 38.8% (Table 2). WHO and UNICEF recommend iodine supplementation during pregnancy and breastfeeding in areas where less than 50% of households have access to iodized salt, or in areas where 50-90% of households have access to iodized salt and where there is no rapid progress towards universal salt iodization. Supplementation can be provided by a single annual oral dose of 400 mg of iodine in the form of iodized oil, or a daily oral supplement of potassium iodide to ensure a total daily iodine intake of 250 µg [27]. These recommendations have not been widely adopted.

In summary, despite the generally poor quality of older trials, there is ample evidence to suggest that supplementation of severely iodine-deficient pregnant women eliminates cretinism and probably increases the average IQ of their children. The effectiveness of iodine supplementation in more mildly iodine-deficient pregnant women is unclear, although such supplementation generally appears to be risk-free. Universal salt iodization remains the mainstay of efforts to prevent iodine deficiency [28].

The rate of vitamin B6 supplementation was higher (45.1%) than the rest of the B vitamins (Table 2).

There is insufficient evidence to detect clinical benefits of vitamin B6 supplementation during pregnancy and/or labor, with the exception of one trial suggesting protection against tooth decay [29].

For vitamin D, C, and omega 3, the intake rates were respectively 36.5%, 34.6%, and 27.3% (table 2). The MENA region registers some of the highest rates of hypovitaminosis D worldwide [30]. In morocco, 90,1% of pregnant women had hypovitaminosis D [31].

Studies have shown that supplementation of pregnant women with vitamin D alone is likely to reduce the risk of pre-eclampsia, gestational diabetes, low birth weight, and the risk of severe postpartum bleeding. But may increase the risk of preterm birth before 37 weeks [32]. In addition, adequate DHA supplementation in pregnant women is essential for fetal brain development in the third trimester and has also been linked to a reduced risk of type 1 diabetes in offspring [33].

Table 2: Overall and specific micronutrient supplement use in pregnant women according to the trimester of pregnancy

		All pregnant Women (n = 384)		1st Trimester (n = 43)		2nd Trimester (n = 41)		3rd Trimester (n = 300)		p-value
		n	%	n	%	n	%	n	%	
Overall supplement use		319	83.1	29	67.4	27	65.6	263	87.7	<0,001
		Specific supplement use								
Vitamins	B1	140	36.5	14	32.6	14	34.1	112	37.3	0,788
	B2	140	36.5	14	32.6	14	34.1	112	37.3	0,788
	B3	58	15.1	5	11.6	6	14.6	47	15.7	0,784
	B5	126	32.8	14	32.6	13	31.7	99	33	0,986
	B6	173	45.1	19	44.2	19	46.3	135	45	0,980
	B8	135	35.2	14	32.6	13	31.7	108	36	0,805
	B9	297	77,3	27	62,8	25	61	245	81.7	<0,001
	B12	140	36.5	14	32.6	14	34.1	112	37,3	<0,001
	A	12	3.1	1	2.3	2	4.9	9	3	0,770
	D	140	36.5	15	34.9	18	43.9	107	35.7	0,575
	E	119	31	13	30,2	13	31,7	93	31	0,989
	C	133	34.6	14	32.6	13	31.7	106	35.3	0,860
Minerals and trace elements	Fe	299	77.9	24	55.8	26	63.4	249	83	<0,001
	Ca	82	21.4	2	4,6	2	4.9	78	26	<0,001
	Mg	178	46,4	20	46.5	20	48.8	138	46	0,945
	Zn	61	15.9	4	9.3	3	7,3	54	18	0,098
	I	149	38.8	17	39.5	18	43.9	114	38	0,763
Other	ω 3	105	27.3	11	25.6	12	29.3	82	27,3	0,931

B1: Vitamin B1; B2: Vitamin B2; B3: Vitamin B3; B5: Vitamin B5; B6: Vitamin B6; B8: Vitamin B8; B9: Vitamin B9; B12: Vitamin B12; A: Vitamin A; D : Vitamin D ; E: Vitamin E ; C: Vitamin C ; Fe: Iron ; Ca: Calcium ; Mg: Magnesium ; Zn: Zinc ; I: Iodine ; ω3: Omega 3.

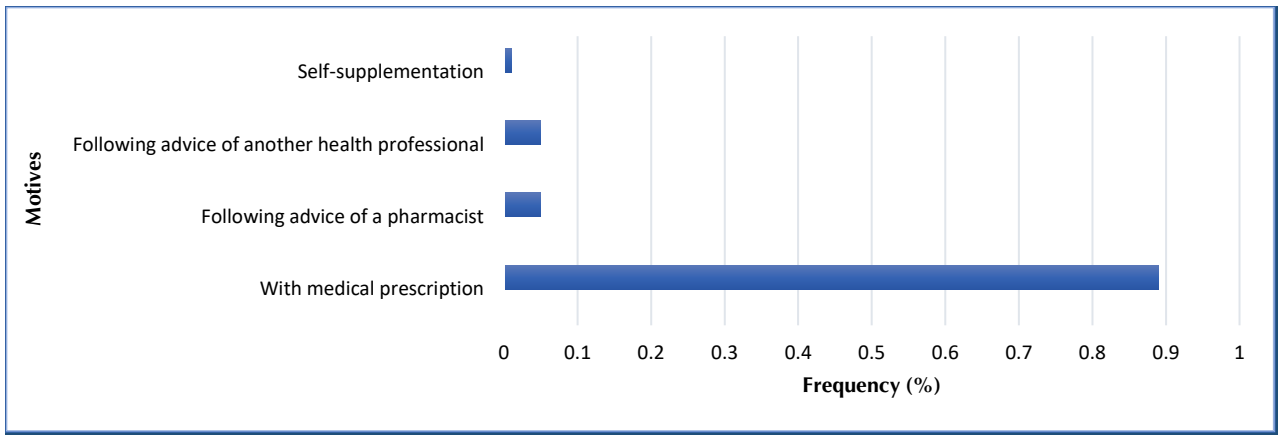

Figure 1: Motives for micronutrient supplement purchase in pregnant women

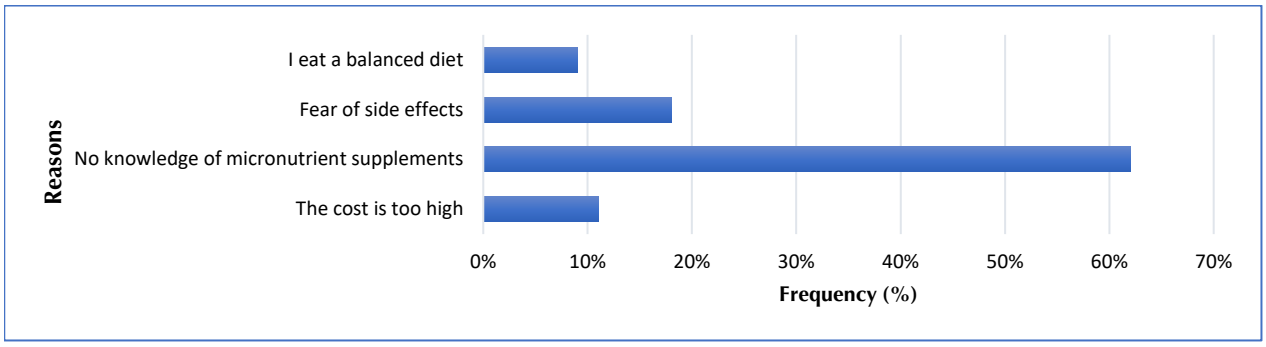

Figure 2: Main reasons for not taking micronutrient supplementation by pregnant women

In a COCHRANE systematic review, preterm births before 37 weeks and very preterm births before 34 weeks were reduced in women taking long chain 3 polyunsaturated fatty acids compared to women who did not take [34].

Regarding vitamin C, data from a systematic review by Rumbold *et al.* [35] do not support routine vitamin C supplementation alone or in combination with other supplements for the prevention of fetal or neonatal death, poor fetal growth, premature delivery or pre-eclampsia.

The vitamin A had the lowest intake rate in this study (Table 2). This finding was confirmed by Pouchieu *et al.* [22]. It is important to note that excessive retinol intake is associated with an increased risk of teratogenicity [36, 37]. According to the WHO, vitamin A supplementation is recommended for pregnant women only in areas where vitamin A deficiency is a severe public health problem, in order to prevent night blindness [19].

In this study, nearly 31% of the women used vitamin E supplements during pregnancy. Data from a systematic review by Rumbold *et al.* [38] do not support the systematic use of vitamin E supplementation, in combination with other supplements, for the prevention of stillbirth, neonatal death, premature delivery, pre-eclampsia or poor fetal growth.

In addition to the prevalence of micronutrients supplementation among Algerian pregnant women, the study highlighted also the factors associated with this supplementation.

The comparative study between users and non-users of micronutrient supplements confirmed the correlation between consumption of micronutrient supplements and the following factors (Table 1):

- **Level of education**

This element represents a motivating factor in the consumption of food supplements, as women with an average or higher level of education were more likely to consume them than others. Certainly, an educated woman has more access to information and is better able to discern information about her own health.

- **Trimester of pregnancy**

Women in the third trimester of pregnancy were more likely to consume micronutrient supplements compared to women in the first and second trimesters. This may be explained by the fact that the nutritional requirements of several key nutrients (folic acid, iron, vitamin D, and iodine) increase in the second and third trimesters, respectively.

- **Parity**

Multiparous women consumed more nutritional supplements than primiparous women. This may be due to the cumulative experience of previous pregnancies.

- **Pre-conception consultation**

A pre-conception consultation seems to encourage the consumption of dietary supplements. The pre-conception consultation has a positive impact on the progress of gestation, it allows the promotion and prevention of pregnancy (advising a varied and balanced diet, considering the need or not for supplementation, etc.).

- **Urbanicity**

The results of this study also show that urbanicity affect positively the consumption of dietary supplements since women living in cities consume more dietary supplements compared to those living in rural areas, and this is because health services are better in urban areas.

- **Physical activity**

According to this survey, pregnant women who are not physically active are more likely to take nutritional supplements. This may be due to the fact that women who are physically active tend to follow a healthy and balanced food diet that may prevent them from taking food supplements.

In fact, serval authors also corroborated the correlation between supplements use and the following factors: level of education, trimester of pregnancy, parity [11, 39, 40], and urbanicity [40, 41].

The authors acknowledge some limitations of this study. First, small sample size. Second, recall bias. Third, longitudinal follow up of the micronutrient supplements use during pregnancy was not available (women were divided referring to their trimester group in a cross-sectional manner).

Despite these limitations, this study permitted an initial quantitative and qualitative approach to the intake of micronutrient supplementation by Algerian pregnant women to be developed on a large scale by other studies.

5 Conclusions

Dietary supplementation is a classic approach to improve the nutritional status of pregnant women in order to ensure a healthy pregnancy. Although, supplementation is generally recommended during pregnancy, there are almost no reports or studies documenting the extent of this practice in Algeria. The study carried out showed that the majority of pregnant women in Sidi-Bel-Abbes city takes micronutrient supplements. It also appears that the use of these supplements depends on a combination of factors such as level of education, pregnancy age, parity, pre-conception consultation, urbanicity, and physical activity.

While, this work was conducted on a small scale, it provided updated and detailed data on micronutrient supplementation for pregnant women. Nevertheless, these results need to be corroborated or refuted by other large-scale human studies.

The collection of these types of data is essential, not only to document the use of dietary supplements, but also to help implement future awareness campaigns regarding the use of dietary supplements during pregnancy and whether they are necessary to ensure adequate micronutrient intake.

Author contribution: B.A. conceived and designed the study and undertook the literature research. All authors participated in the experiment and data acquisition. M.S. and O.B. performed the data analysis. A.B. carried out the statistical analysis, prepared, reviewed, and drafted the manuscript. All authors approved the final version before submission. All authors have read and agreed to the published version of the manuscript.

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