Dietary Vitamin A intakes among Pregnant Women Attending Antenatal Care in Health Facilities: As a connotation for the progress of Vitamin A Deficiency in Dessie Town, North East Ethiopia: A cross-sectional Study

Zenebech Koricho

Dessie Hospital

tefera Chane Mekonnen (✉ teferachane@gmail.com)

Wollo University <https://orcid.org/0000-0003-4680-3645>

Gudina Egata Atomssa

Haramaya University College of Health and Medical Sciences

Sisay Eshete Tadesse

Wollo University

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Abstract

Vitamin A plays an important role in vision, cellular differentiation, embryonic development, reproduction, growth, and the immune system. Women who live in developing countries face a risk of undernutrition during pregnancy due to poverty, poor diet quality and quantity, and high fertility rate. This poor dietary problem could reflect women's high risk of vitamin A deficiency. The major aim of this study was to determine the adequacy of vitamin A among pregnant women following antenatal care in health facilities of Dessie Town, Ethiopia, January 2017. Health facility-based cross-sectional study was conducted among 390 women that attended antenatal care in Dessie Town. The food groups from FAO based on 24 hour dietary recall was used to measure dietary intake Vitamin A and dietary diversity of women. Adequacy of vitamin A was determined from nutrient adequacy ratio after obtaining reports of nutrient intake from food composition table version III and IV in terms of B carotene and retinol equivalent respectively, based on the estimated average requirement recommendation of vitamin A, 370 RE/day for pregnant women. Multivariable Logistic regression analysis was done to identify associated factors of vitamin A adequacy.

Background

Vitamin A is an essential nutrient that plays a crucial role in the vision, cellular differentiation, embryonic development, reproduction, growth and the immune system (1–2). Its deficiency called Vitamin A deficiency (VAD) is the third most common nutritional deficiency in the world and the most severe deficiency disorder in Southeast Asia and Sub-Saharan Africa (3).

Dietary sources of vitamin A are preformed vitamin A; and pro-vitamin A, which are those Carotenoids precursors that can be bio-converted to retinol. Pro-vitamin A sources contribute 30–35% of the total vitamin A in the food supplies of industrialized populations, which is 70–75% in the populations of Africa and Southern Asia (4). These dietary intake data indicate

Nutritional adequacy is defined as having sufficient intake of essential nutrients including vitamin A and needed to fulfill nutritional requirements for optimal health, the prevention of chronic diseases or the reduction of risk for diet associated diseases (5). Having low vitamin A intake during the period of critical human life stages; such as infancy, childhood, pregnancy and lactation increases the risk of vitamin A deficiency disorders (VADD) (6, 7). Dietary diversity scores can be used as a proxy measure of micronutrient and diet adequacy of women (8). It has been linked to less reporting of a major pregnancy related complications, like preeclampsia and Eclampsia (9, 10).

The most common cause of Vitamin A deficiency is lack of intake good diet which has Vitamin A. When dietary intake is chronically low, there will be insufficient vitamin A to support the vision and cellular processes, leading to impaired tissue function (11, 12). Studies have shown that improving vitamin A status can reduce pregnancy-related mortality by about 40 % (7, 13).

However, there is a considerable progress has been seen in controlling Vitamin A deficiency in the world, still it needs additional prevention efforts in the form of dietary approaches (13, 14).

In Ethiopia a strategy involving multiple stakeholders and public–private partnership is well designed with the National Nutrition Program (NNP) with implementing sectors have declared and pledged their commitment to

support the achievement of the targets of the program (15).

But these efforts don't solve VAD within pregnant women in the country. So during the period of pregnancy, it is a window of exposure for nutritional detrimental effects. As a result, this study was conducted on the adequacy of vitamin A among pregnant women that attended antenatal care in health facilities of Dessie Town as these people are part and parcel of the vulnerable groups in Ethiopia.

Methods

- Study Area and Period

A health facility-based cross-sectional study was conducted from January 12 to February 12, 2017 in Dessie Town located 401 Kms far from the capital city, Addis Ababa and 480 kms from the regional capital city, Bahir Dar, Ethiopia. Total population in Dessie Town was 216,384, among which 7,292 were expected to be pregnant women. There are 12, 17 and 4 governmental, private and nongovernmental health facilities (total of 33 health facilities) in Dessie Town respectively. Among the total pregnant women, 4397 pregnant women have got ANC in 2016 in the governmental, private and nongovernmental health facilities of the Town.

Maternal and child health care services are given in most of government, some private and nongovernmental health facilities like immunization, family planning, antenatal care, delivery care and postnatal care. In Dessie Town available common food products include cereals, grains, legumes, dairy products, egg, fish, meat, fruits (Mango, papaya, Avocado, Orange) and vegetables (Spinach, Lettuce, Green pepper, carrot, pumpkin, cabbage).

Study population were, all pregnant women who were attending ANC in 12 randomly selected health facilities (government, private and nongovernmental health facilities) of Dessie town. All pregnant women who were attending in the randomly selected government, private and nongovernmental health facilities of Dessie Town were included. Pregnant women found in a fasting day and have a dietary restriction were excluded from the study.

Sample size and Sampling Technique

The sample size was determined using single proportion population formula by considering the following assumptions of proportion, 50% of adequacy of vitamin A, confidence level of 95%, margin of error 5% and 10% as non-response rate, the total sample size was 422.

In Dessie Town, 17 health facilities provide ANC service, among which 12 health facilities were randomly selected (07 governmental, 04 private and 01 non-governmental). The sample size was allocated proportionally to the client flow of each health facility. Those pregnant women who fulfilled the inclusion criteria and visited the ANC clinic during the study period were systematically selected as study participants after obtaining an identification card of each pregnant woman

- Data collection Techniques and Data Measurements

An Interviewer-administered pre-tested questionnaire was used for dietary data from known sources (7, 16–18). The questionnaire was prepared by local language (Amharic) and then their response translated to English for the purpose of this study. Eight data collectors and two supervisors were hired and participated based on their prior exposure of research data collection.

The socio-demographic features (such as age, educational level, occupation, marital status, income level, family size), obstetrics related characteristics (birth interval, parity, months of pregnancy) and dietary intake and habits of pregnant women (food taboos, nutrition education, daily intake of vitamin A rich sources, reasons for not daily taking of vitamin A rich vegetables, poultry production, home gardening of vegetables) were assessed to investigate the research objective.

Adequacy of vitamin A and Women dietary diversity score (WDDS) were measured by using the nine food groups from FAO dietary diversity guideline based on interactive 24 hours dietary recall. Details of the food groups were probed or interviewed from each participant. Dietary information was assembled and estimated using portion size and gram amounts to know the Carotenoids equivalent and retinol equivalent (RE). And then to determine the level of adequacy, individual RE from each food group was summed. The corresponding nutrient adequacy ratio (NAR) was calculated. As recommended by joint FAO/WHO consultation, mean requirement of vitamin A in mcg RE/day for pregnant women is 370 and safe intake in mcg is 600 RE/day. Adequacy of vitamin A was defined as a daily intake of the vitamin from plant and/or animal sources that is equal to the estimated average requirement of vitamin A, 370mcg RE/day.

So the adequacy of Vitamin A categorized using a cutoff value of 1 as adequate and <1 as inadequate (12, 17).

The WDDS was classified as low, medium and high, according to the FAO's classification of WDDS as "low" if WDDS <3, as "medium" if WDDS ranged 4–5 and as "high" if WDDS ≥ 6 (17).

Dietary intake of vitamin A of each study participant was converted to gram amounts then gram amounts calculated to Carotenoids equivalent as per 100 gram edible portion in the food composition table of Ethiopia.

Carotenoids equivalents were converted to retinol equivalent (RE) by a conversion factor of six. Foods that have retinol values were simply recorded and summed to values obtained by conversion of the Carotenoids to retinol (RE). To determine nutrient adequacy ratio (NAR) of vitamin A, the ratio of observed intake was calculated in relation to recommended intake based on estimated average requirement (EAR) of 370 mcg RE/day (12).

- Data Quality Control

Training was given for data collectors on the objectives of the study and items of the data collection tools. Information about the essential technical skills on how to collect a 24 hour dietary recall method was also part of the training. Frequent supervision and checking of the data for its consistency and completeness was done. To reduce recall bias on dietary data, corresponding portion size of dietary intake was estimated by local measurement utensils by allowing study participants to choose from a variety of commonly used local measurement utensils offered during data collection and show which variety of local measurements were used for the portion size of their diet. Gram amounts for the portion sizes were determined as per the food composition table of Ethiopia (per 100 gram edible portion). Some consumed foods were estimated by their raw portion size or gram amounts.

Data management and analysis

Data entry was done using Epi-Info 7.2 software program and data cleaning was also done by using SPSS version 20 software program. The food composition table of Ethiopia version III and IV were used to convert raw

dietary data to Carotenoids equivalent and retinol equivalent of vitamin A rich foods consumed in the past 24 hours.

Descriptive statistics such as percentage, mean and standard deviation were done to express the findings. After dichotomizing the dependent variable, binary logistic regression and multiple logistic regression analysis were done to see the association of independent variables on the outcome variable and to control the possible confounding effects. The Odds ratio was used to assess the presence and degree of association between dependent and independent variables. A P-value less than 0.05 used to decide whether the differences that occur would be statistically significant or not.

Results

Socio-demographic and economic characteristics of pregnant women

Out of sampled 422 pregnant women, 390 women were participated with 92.4% response rate.. The mean age of the respondents was 26.89 ($\pm$ 4.63 SD) years. Among the study participants 41 (10.5%), 95 (24.4%), 185 (47.4%), and 69 (17.7%) were unable to read and write, attending primary schooling, secondary schooling and college and above in their educational background respectively. The mean gestational age was 6.16 ($\pm$ 2.21SD) months (Table 1).

Dietary diversity and Vitamin A adequacy of Pregnant Women

Poultry production & home gardening of vegetables for own consumption was assessed to see the availability of rich sources of Vitamin A. About one in every five pregnant women (22%) consumed vitamin A rich fruits and vegetables in daily basis (Table 2).

The foods eaten by the pregnant women were predominantly starchy staple foods (99.7%), other fruits and vegetables (98.7%), and legumes (84.9%) (Fig1). Women dietary diversity score (WDDS) from the nine food groups were measured and 26.9%, 55.4% and 17.7% of pregnant women found to have low, medium and high dietary diversity score respectively. The mean WDDS was 4.36 ± 1.2 SD.

The average dietary Vitamin A intake was 294.1 μ g of retinol equivalents or 185.3 μ g retinol activity equivalents. The average nutrient adequacy ratio of vitamin A from both preformed and pro-vitamin A sources was 0.9. About two in every five pregnant women (41.8%) had an adequate dietary intake of vitamin A (equivalent of recommended daily allowance of vitamin A). Regarding vitamin A intake from major food sources, Mango contributed RE about 19.5% of pregnant women in its juice or flesh form; this seems an emerging tendency to use it as food of choice by pregnant women.

Factors Associated with Adequacy of Vitamin A

In the Bivariable logistic regression analysis, occupation, no poultry production for own consumption, gardening of vegetables for own consumption and women dietary diversity score (WDDS) were associated with the adequacy of vitamin A.

Even though many independent variables reached the final step, with multivariable logistic regression analysis, WDDS and no poultry production were found to be significantly associated with the adequacy of vitamin A.

The odds of vitamin A adequacy among pregnant women with high WDDS was 2.9 times higher than the odds of vitamin A adequacy among pregnant women with low WDDS (AOR = 2.92; CI: 1.50–5.70). Similarly, the odds of vitamin A adequacy among pregnant women with medium WDDS was 1.9 times higher than the odds of vitamin A adequacy among pregnant women with low WDDS (AOR = 1.87; CI: 1.11–3.16).

However, occupational status of pregnant women, rearing of poultry and having home gardening for cultivating vegetables were not significantly associated with the adequacy of vitamin A intake (Table 3).

Discussion

The current study provided a rough estimation of dietary vitamin A intake among pregnant women in which the mean intake was found to be 294.1 µg RE/day. This finding was much lower than the mean intake of vitamin A among women in Asian countries like China (19), Korea (20) and Japan (21), European and American countries, such as Italy (22), Spain (23), Mexico (24) and United States (25) that ranged from 480.9 µg RE/day in China to 890 µg RE/day in Italy. The variation among the current finding and findings from the above mentioned countries may be due to clear differences in socio-economic status, knowledge and skills for proper dietary practices. The other reason for the discrepancies in proportion of adequate intake of vitamin A may be the use of different recommendations of vitamin A intake in different countries.

Moreover, the percentage inadequate intakes of vitamin A among pregnant women was about 58%; those pregnant women who cannot meet the average requirement of vitamin A in µg RE/day of 370 as recommended by the joint FAO/WHO consultation (17). This finding was roughly consistent with the findings of the studies conducted in Indonesia central Java (26) and South Africa (27) which were 59.5% and 62.5% respectively. The apparent difference between the two proportions of adequacy may be due to the higher estimated average requirement of South Africa (550mcg RE/day) for pregnant women. The low proportion of adequacy of dietary vitamin A intake was found to be similar in low income countries as stated above that may be due the presence of low economy and poor dietary practices and knowledge seeking behavior. However, a significant difference in adequacy of vitamin A among pregnant women was observed in Sirilanka (28) as compared to the present study.

The major contributors of vitamin A for consumption among pregnant women were plant sources, particularly vegetables and fruits as pro-vitamin A form and mango took the loin share contribution of Carotenoids. The retinol share of dietary vitamin A was negligible in which the overall consumption of meat, eggs and dairy were below 25%.

In multiple logistic regression analysis, women dietary diversity score was found to be significantly associated with nutrient adequacy ratio of vitamin A. The odds of adequacy of vitamin A among pregnant women with high WDDS were about three times higher than the odds of adequacy of vitamin A among pregnant women with low WDDS. This result is comparable with two studies conducted in Ethiopia, Rural Sidama and Wolaita, Southern Ethiopia (29, 30). The higher diversified diet the women consume, the more nutrient adequacy expected and less risky for micronutrient deficiencies. The result was also in line with the theoretical knowledge that low dietary diversity is related to inadequacy of nutrients including vitamin A. Nutrition specific interventions and nutrition

sensitive intervention programs determine the immediate determinants of fetal and maternal health, i.e. adequate food and nutrient intake through dietary diversification and modification integrated with sound promotion work.

Even though it was not significant, pregnant women who consume poultry from their produce had the highest dietary intake of vitamin A. Consumption of poultry can directly contribute to the total pool of retinol equivalent without a conversion factor (31).

Assessment of vitamin A adequacy measures risk of vitamin A deficiency, but not vitamin A status or vitamin A deficiency. How much of beta carotene was absorbed and also converted to RE was not estimated in this study. Leftover foods were not estimated. Some foods were estimated by raw portion size. Laboratory assessment along with functional test of vitamin A nutriture investigation was recommended to know the actual burden of the vitamin A deficiency among this vulnerable population group.

- **Conclusions:**

In this study adequacy of vitamin A was found to be low which demonstrated a risk of vitamin A deficiency among the studied pregnant women. This signal indicates there should be reinforcement of a new focus on food-based approach and vitamin A supplementation to reduce the risk of vitamin A deficiency among pregnant women. Women dietary diversity score was a predictor of vitamin A adequacy in this study. It is proved that dietary diversity during pregnancy was crucial to increase the adequacy of vitamin A.

Advocacy and promotion work is needed to facilitate improved dietary intake by pregnant women; to this end preparing an algorithm for nutritional counseling is the mandate of the top level health department in order to create commonness in the message throughout the health facilities in the studied area.

Abbreviations

ANC: Antenatal Care; FAO: Food and Agricultural Organization; NAR: Nutrient Adequacy Ratio; RE: Retinol Equivalent; SD: Standard Deviation; VAD: Vitamin A Deficiency; WDDS: Women Dietary Diversity Score.

Declarations

Ethics approval and consent to participate: Ethical clearance was obtained from the ethical review committee of the College of Medicine and Health Sciences of Wollo University. All study participants were reassured that name was not needed and would not be recorded. Chances were given to ask anything about the study and being made free to refuse or stop the interview at any moment they want. Written informed consents were obtained from the study participants.

Consent to Publication: not applicable.

Availability of Data and Material: the datasets during and/or analyzed during the current study is available from the corresponding author on reasonable request.

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Competing interest: the authors declared that they have no conflict of interest.

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Authors' contribution: ZK: write up the proposal, did the data collection and analysis and involved in manuscript preparation and revision. TCM: involved in the proposal development, data analysis and made the manuscript ready for submission. GE and SE: involved in proposal development and revision of the manuscript. All authors have read and approved the final manuscript' and All authors contributed equally.

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Tables

Table 1: Socio-demographic and economic characteristics of pregnant women in health facilities of Dessie Town, Ethiopia in May 2017.

Variables	Number of study participants (n=390)	Percentage
Maternal Education		
Unable to read and write	41	10.5
Primary schooling	95	24.4
Secondary schooling	185	47.4
College and above	69	17.7
Maternal Occupation		
Unemployed	14	3.6
Government employed	321	82.3
Merchant	55	14.1
Age of pregnancy(in Wks)		
First trimester	61	15.6
Second trimester	142	36.4
Third trimester	187	48.0
Mean gestational age $\pm$ SD	6.16 $\pm$ 2.21 months	
Family size		
<3	174	44.6
3-4	66	16.9
≥ 5	150	38.5
Pregnancy related illness		
Yes	201	51.5
No	189	48.5
Common illness during pregnancy		
Dyspepsia	18	8.9
Morning sickness	166	82.6
Helminthes infestation	17	8.5
Birth interval (n=209)		
1-5 years	141	67.5
>5 years	69	32.5
Parity		
0	282	72.3
1	108	27.7
≥ 3		
Maternal nutrition education		
Yes	96	24.6
No	294	75.4

Table 2: Nutritional information of pregnant women, health facilities of Dessie Town, Ethiopia in May 2017.

Variables	Number of study participants	
	(n=390)	%
Daily intake of vitamin A rich vegetables and Fruits		
Yes	86	22.0
No	304	77.9
Reasons for no Daily intake of vitamin A rich vegetables (n=304)		
Vitamin A rich sources available during market day	67	
17.2		
No fresh products except market days	45	11.5
Socio economic reasons	192	49.2
Poultry production		
Yes	56	14.4
No	334	85.6
Home garden		
Yes	63	16.2
No	327	83.8

Table 3: Multivariable logistic regression analysis for associated factors of adequacy of vitamin A in pregnant women, health facilities of Dessie Town, Ethiopia May 2017.

Variables	Vitamin A		COR (95% CI)	AOR (95% CI)
	Adequate	Inadequate		
Occupation				
Unemployed	24(14.7%)	60(26.4%)	1	
Government employed	117(71.8%)	134(59.0%)	2.18(1.27-3.72) **	1.64(0.93-2.88)
				1.26(0.59-2.68)
Merchant	22(13.5%)	33(14.5%)	1.66(0.81-3.41)	
Poultry production				
Yes	16(9.8%)	40(17.6%)	1	1
No	147(90.2%)	187(82.4%)	1.96(1.05-3.64)*	1.55(0.80-3.00)
Gardening of vitamin A rich vegetables				
Yes	19(11.7%)	44(19.4%)	1	1
No	144(88.3%)	183(80.6%)	1.82(1.02-3.25)*	1.55(0.84-2.88)
WDDS				
Low WDDS	29(17.8%)	76(33.5%)	1	1
Medium WDDS	95(58.3%)	121(53.3%)	2.05(1.24-3.41)***	1.87(1.11-3.16)*
High WDDS	39(23.9%)	30(13.2%)	3.40(1.79-6.46)***	2.92(1.50-5.70)**

NB: * significant variable at p value <0.05, **significant variable at p value

<0.001

Figures

Figure 1

food groups consumed by pregnant women having ANC follow up in Health facilities of Dessie Town, Amhara Region, Ethiopia in May 2017.