

VITAMIN “A” FOOD CONSUMPTION BY PREGNANT WOMEN IN BRAZIL: A SYSTEMATIC REVIEW

Consumo alimentar de vitamina A por gestantes no Brasil: uma revisão sistemática

Consumo alimentario de vitamina A en embarazadas de Brasil: una revisión sistemática

Review Article

ABSTRACT

Objective: To conduct a systematic review of the Vitamin “A” food consumption by pregnant women in Brazil. **Methods:** The review consisted of a search for articles published in the period from 1999 to 2015 in SciELO, PubMed, and LILACS databases. At the end, eight articles were selected for this review. **Results:** The methods used for the analysis of the intake of vitamin “A” were: food frequency questionnaire (FFQ) – considering the diet or only vitamin “A” foods and the dietary recall (24hDR). Only two articles estimated the adequacy of the **Vitamin “A” food consumption** by the population assessed. Some methodological limitations were quite frequent, emphasizing the lack and/or limitation of information on the sample representativeness, loss of studies, accuracy of the methods applied and the control of confounding variables. **Conclusion:** It is observed that there are still few studies that critically assess the Vitamin “A” food consumption by pregnant women in Brazil, and that the identification and control of possible biases of the dietary surveys can improve the reliability of the information found.

Descriptors: Vitamin A Deficiency; Food consumption; Food Intake; Vitamin A; Pregnancy.

RESUMO

Objetivo: Realizar uma revisão sistemática sobre o consumo alimentar de vitamina A por gestantes no Brasil. **Métodos:** A revisão constituiu na busca de artigos publicados no período de 1999 a 2015 nas bases SciELO, PubMed e LILACS. Ao final, foram selecionados oito artigos para esta revisão. **Resultados:** Os métodos utilizados para análise do consumo de vitamina A foram o questionário de frequência alimentar (QFA) – da dieta ou apenas de alimentos fontes de vitamina A – e o recordatório alimentar (R24h). Apenas dois artigos calcularam a adequação da ingestão de vitamina A para a população avaliada. Algumas limitações metodológicas foram bastante frequentes, destacando-se a ausência e/ou limitação de informações sobre representatividade da amostra, perdas do estudo, acurácia dos métodos aplicados e controle das variáveis de confusão. **Conclusão:** Observa-se que ainda são escassos os estudos que avaliam de forma criteriosa o consumo de vitamina A por gestantes no Brasil, e que a identificação e controle dos possíveis vieses do inquérito dietético poderão melhorar a fidedignidade dos dados encontrados.

Descritores: Deficiência de Vitamina A; Consumo Alimentar; Ingestão de Alimentos; Vitamina A; Gravidez.

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RESUMEN

Objetivo: Realizar una revisión sistemática sobre el consumo alimentario de vitamina A en embarazadas de Brasil. **Métodos:** La revisión se dio por la búsqueda de artículos publicados en el periodo entre 1999 y 2015 en las bases de datos SciELO, PubMed y LILACS. Por fin fueron seleccionados ocho artículos para esta revisión. **Resultados:** Los métodos utilizados para el análisis del consumo de la vitamina A fueron el cuestionario de la frecuencia alimentaria (QFA) – de la dieta o solamente de alimentos fuentes de vitamina A – y el recordatorio de 24h (R24h). Solamente dos artículos calcularon la adecuación para ingestión de vitamina A para la población evaluada. Algunas limitaciones metodológicas fueron muy frecuentes, destacándose la ausencia y/o limitación de informaciones sobre la representatividad de la muestra, las pérdidas del estudio, la eficacia de los métodos aplicados y el control de las variables de confusión. **Conclusión:** Todavía se observan pocos estudios que evalúan con criterios el consumo de la vitamina A en las embarazadas de Brasil y que la identificación y el control de los posibles sesgos de la averiguación dietética puede que mejore la fidedignidad de los datos encontrados.

Descriptores: Deficiencia de Vitamina A; Consumo de Alimentos; Ingestión de Alimentos; Vitamina A; Embarazo.

INTRODUCTION

Vitamin A is an essential nutrient that is important in promoting growth and development, and also in maintaining immune and reproduction functions^(1,2), with a major role in periods of intense proliferative growth and tissue development in pregnancy and fetal development⁽³⁾.

Vitamin A deficiency (VAD) is among the top priorities of micronutrient deficiencies, affecting about 210 million children under the age of five and also pregnant and lactating women worldwide^(2,4). In Brazil, one of the most affected countries in America, data from the latest *Pesquisa Nacional de Demografia e Saúde da Criança e da Mulher - PNDS*⁽⁵⁾ (National Survey on Demography and Health of Women and Children) conducted in 2006 indicated that 12.3% of women presented inadequate levels of vitamin A, with the highest inadequacy rates found in the Northeast (19.0%) and Southeast (21.6%) regions of the country.

VAD is common in pregnancy and compromises the outcome of the pregnancy process in many ways, contributing to infections⁽⁶⁾, prematurity⁽⁷⁾, low birth weight⁽⁸⁾, anemia⁽⁹⁾, malformations⁽¹⁰⁾ and hypertensive syndromes in pregnancy⁽¹¹⁾; however, its effects on maternal and child mortality are still inconclusive⁽¹²⁻¹⁴⁾. It is mainly caused by the low intake of food sources⁽²⁾, but it can also be associated with other factors such as socioeconomic status and inadequate sanitation⁽¹⁵⁾.

Given the complexity and high cost of research on a large scale to estimate the prevalence of vitamin A deficiency through biochemical indicators, food surveys can be a valuable tool for assessing the nutritional status of individuals. The choice of method depends on the study population and objective⁽¹⁶⁾.

In pregnant women, changes in the physiological and psychological state can influence the results of analytical studies of food consumption. The methods that best apply to epidemiological studies are the 24-hour dietary recall (24HR), dietary history (DH) and the food frequency questionnaire (FFQ), all of retrospective nature⁽¹⁷⁾. However, the use of consumption assessment tools without following a rigorous application methodology does not generate reproducible results. In Brazil, few studies have addressed vitamin A consumption by pregnant women. In this sense, the present study aimed to conduct a systematic review of the vitamin A food consumption by pregnant women in Brazil.

METHODS

The present study is a systematic review of literature consisting in a retrospective search of scientific articles on research conducted in Brazil and published in national or international journals that analyzed the consumption of vitamin A by pregnant women through dietary surveys.

Articles were identified through a search of the following databases: SciELO (Scientific Electronic Library Online), LILACS (Latin-American and Caribbean Center on Health Sciences Information) and PubMed (National Library of Medicine, Bethesda, MD). The descriptors used were: “(vitamin A deficiency) AND (food consumption OR eating) AND (vitamin A) AND (pregnancy)” and their counterparts in Portuguese and Spanish according to the terminology used on the website *Descritores em Ciências e Saúde – DeCS* (Health Sciences Descriptors). This review included publications dating from 1999 to 2015. This long period of time used for the inclusion of articles was due to the lack of studies assessing vitamin A consumption by pregnant women in the country and the lack of national surveys with the same objective that is proposed in this study.

The search was conducted independently by three examiners according to the following eligibility criteria: cohort, case-control and cross-sectional studies published in Portuguese, English and Spanish.

The selection of the studies took place in three stages. Initially, through the analysis of the titles of the articles, the examiners evaluated those identified through the combinations of descriptors on the databases. Then, after

selecting the relevant titles, the examiners read the abstracts. When more information was needed, the text would be fully read to check whether it was relevant to the study and then analyzed.

The articles were evaluated as for methodological and scientific aspects that were established based on a scale⁽¹⁸⁾ proposed to evaluate the methodological quality of studies. The aspects evaluated were: year of publication, language, design and duration of the study, sample size, losses, method used to assess vitamin A consumption, objective of the application, average consumption of vitamin A, consumption adequacy ratio in relation to the nutritional recommendations (AI%), main results, statistics employed, independent variables, biases and confounders. To facilitate the analysis and discussion, the data were organized in tables presented in the results section of this review.

RESULTS

The literature search yielded 9,065 articles: 346 on the SciELO database, 814 on LILACS and 7,905 on PubMed. Of these articles, 99 specifically addressed the issue of interest; however, the articles repeated on different databases were excluded⁽⁹¹⁾. In the end, eight articles were selected for this review (Figure 1).

Table I presents a description of the studies according to year of publication, design, duration, sample and losses.

It was observed that the majority of studies (87.5%) were cross-sectional^(15,19-24). It is noteworthy that the latest study was published in 2011⁽²⁵⁾ and no publications on the issue have been found - according to the descriptors used - in the last three years. Regarding the characteristics of the sample, only four studies^(15,21-24) described the age of the participants. The other reported only the mean age of participants^(22,25) and in some cases no information on these characteristics was provided^(19,20). Only one study reported information on losses in the study group⁽²⁴⁾.

Table II shows that four articles did not describe the distribution of confounders^(19,20,23,25), and only two articles^(19,21) had a representativeness of individuals included in the study; therefore, data are not amenable to generalization. All the articles selected for this review used a statistical analysis applied to the proposed objective, except one study⁽²²⁾ whose statistical method was not very clear.

According to Table III, all the studies used the 24HR and/or FFQ as research methods to assess food consumption in pregnant women. The 24HR method was used in five articles: three used it alone^(20,22,23) and two used it combined with the FFQ^(21,24). The FFQ was used alone in three studies^(15,19,25). As for vitamin A consumption in this population, one study⁽¹⁵⁾ did not quantify the intake and verified its frequency only. Among the other articles, only two^(22,23) estimated vitamin A intake adequacy.

Table I - Description of studies on vitamin A consumption by pregnant women in Brazil from 1999 to 2015 according to year of publication, characteristics of the sample and losses.

Authors	Year of publication	Study design	Characteristics of the initial sample	Study losses
Rondó et al. ⁽¹⁹⁾	1999	Cross-sectional	Pregnant women (age group not reported) - n=710	Unreported
Saunders et al. ⁽²⁰⁾	2000	Cross-sectional	Pregnant women (age group not reported) - n=198	Unreported
Villar and Roncada ⁽²¹⁾	2002	Cross-sectional	Pregnant women (19-40 years) - n=91	Unreported
Nascimento and Souza ⁽²²⁾	2002	Cross-sectional	Overweight pregnant women (mean age of 26 years) - n=110	Unreported
Azevedo and Sampaio ⁽²³⁾	2003	Cross-sectional	Pregnant adolescents (14-19 years) - n=91	Unreported
Giacomello et al. ⁽²⁴⁾	2008	Cross-sectional	Pregnant women (15-42 years) - n=161	9 losses
Santos et al. ⁽¹⁵⁾	2010	Cross-sectional	Pregnant women (18-35 years) - n=92	Unreported
Fazio et al. ⁽²⁵⁾	2011	Retrospective	Pregnant women (mean age of 30.6 anos) - n=197	Unreported

Table II - Methodological and scientific aspects of studies on vitamin A consumption by pregnant women in Brazil from 1999 to 2015.

Authors	Year of publication	Independent variables	Bias/ Confounders	Main results	Statistical analysis
Rondó et al. ⁽¹⁹⁾	1999	—	—	49.5% of pregnant women at low risk and 50.5% at moderate risk for vitamin A deficiency	- Analysis of variance - Spearman's Correlation Coefficient
Saunders et al. ⁽²⁰⁾	2000	—	—	Large fluctuation of average values of vitamin A	- Analysis of variance - Tukey's test
Villar and Roncada ⁽²¹⁾	2002	Gestational period, education level, occupation	Seasonality, eating habits and different trimestres of pregnancy	55% of pregnant women with average consumption of vitamin A above the recommendations	- Analysis of variance - Spearman's Correlation Coefficient - Cohen's Kappa
Nascimento and Souza ⁽²²⁾	2002	Age, education level, income, number of previous pregnancies, weight, height, body mass index	Nutrition counselling of pregnant women prior to data collection	Diet was satisfactory as for energy, carbohydrates and proteins; lipids and vitamins A and C reached and/or exceeded the recommended amounts while calcium, iron and folate presented an adequacy rate of 50%, 33%, and 43%, respectively	- Test for difference of means (?)
Azevedo and Sampaio ⁽²³⁾	2003	Age, household income, education level, housing conditions, gestational age, weight, height, body mass index	—	Vitamin A and C intake reached a percentage of 100% in 58.2% and 53.3% of pregnant women, respectively. 63.6% of the diets had less than 90% of energy needs and more than half was adequate in protein, high in lipids and low in carbohydrates. Iron, calcium, folic acid, vitamin B 1 and zinc were consumed well below the recommended	Distribution of frequencies

Giacomello et al. ⁽²⁴⁾	2008	Marital status, level of occupation, education level, nutrition counselling, age group, gestational age, number of people in the house, income per capita	Education level, socioeconomic status, short time for data collection and lack of measures to quantify the interviewer and interviewee bias	The FFQ overestimated the consumption of energy and nutrients. There were low rates of vitamins A and C and high rates of fibers, vitamin C, folic acid, calcium and potassium	<ul style="list-style-type: none"> - Test for the comparison of means/variables (T-test and chi-squared) - Agreement test and correlation of methods: LOAS, Cohen's Kappa, crude and adjusted Pearson's correlation coefficient
Santos et al. ⁽¹⁵⁾	2010	Age, income per capita, education level, marital status, nutritional status, history of abortions, number of pregnancies, interurrences	Socioeconomic status and eating habits	There was a lower consumption of vitamin A by pregnant women with night blindness	<ul style="list-style-type: none"> - Fisher's exact test - Wilcoxon test
Fazio et al. ⁽²⁵⁾	2011	Weight, height, body mass index	—	Low weight pregnant women presented a lower intake of lipids compared to their normal weight peers. The daily intake of vitamin A, vitamin C, and calcium was similar between groups. The average iron and folate intake was higher in normal weight pregnant women compared to their overweight and underweight peers	<ul style="list-style-type: none"> - Frequency distribution - Chi-squared test

Table III - Methods for assessing food consumption, objective of the application of the method, average vitamin A consumption and intake adequacy rate (IA%).

Authors	Year of publication	Method for assessing food consumption	Objective of the application of the method	Average vitamin A consumption (µgRE)	IA (%)
Rondó et al. ⁽¹⁹⁾	1999	1 FFQ*	To analyze the risk of VAD*** in pregnant women	487,10	-
Saunders et al. ⁽²⁰⁾	2000	1 24HR**	To check fluctuation of the average content of vitamin A in diet plans of pregnant women based on 5 different food composition tables	1008.89 (INCAP****, 1961) 1204.90 (FIBGE****, 1996) 1494.06 (Table of the Maternal and Infant Nutrition Research Group of the UFRJ, 1996) 793,02 (Table of Franco, 1992) 908,97 (Table Handbook, (1993))	-
Villar and Roncada ⁽²¹⁾	2002	1 simplified dietary form	To identify the consumption of food sources of vitamin A in pregnant women	1134.00	-
Nascimento and Souza ⁽²²⁾	2002	1 24HR	To check the energy value and nutritional adequacy of diet plans of pregnant women	1059.40	132.43%
Azevedo and Sampaio ⁽²³⁾	2003	24HR – 3 nonconsecutive days	To analyze food consumption of pregnant women	820.80	58.2%
Giacomello et al. ⁽²⁴⁾	2008	1 FFQ – validated; 24HR (2 for pregnant women interviewed once and 4 for pregnant women interviewed twice on nonconsecutive days)	To assess the efficacy of the food frequency questionnaire in quantifying food consumption of pregnant women	24HR = 927.00 FFQ = 1601.00	-
Santos et al. ⁽¹⁵⁾	2010	1 FFQ (qualitative)	To analyze the frequency of the consumption of food sources of vitamin A in pregnant women	Not assessed	-
Fazio et al. ⁽²⁵⁾	2011	1 FFQ	To assess the intake of macro and micronutrients according to maternal nutritional status	Underweight = 693.70 Normal = 703.00 Overweight = 666.10 Obesity = 519.8	-

*FFQ: Food Frequency Questionnaire;

**24HR: 24-hour dietary recall;

***VAD: Vitamin A deficiency;

****Instituto de Nutrição Centro América y Panamá

*****Fundação Instituto Brasileiro de Geografia e Estatística

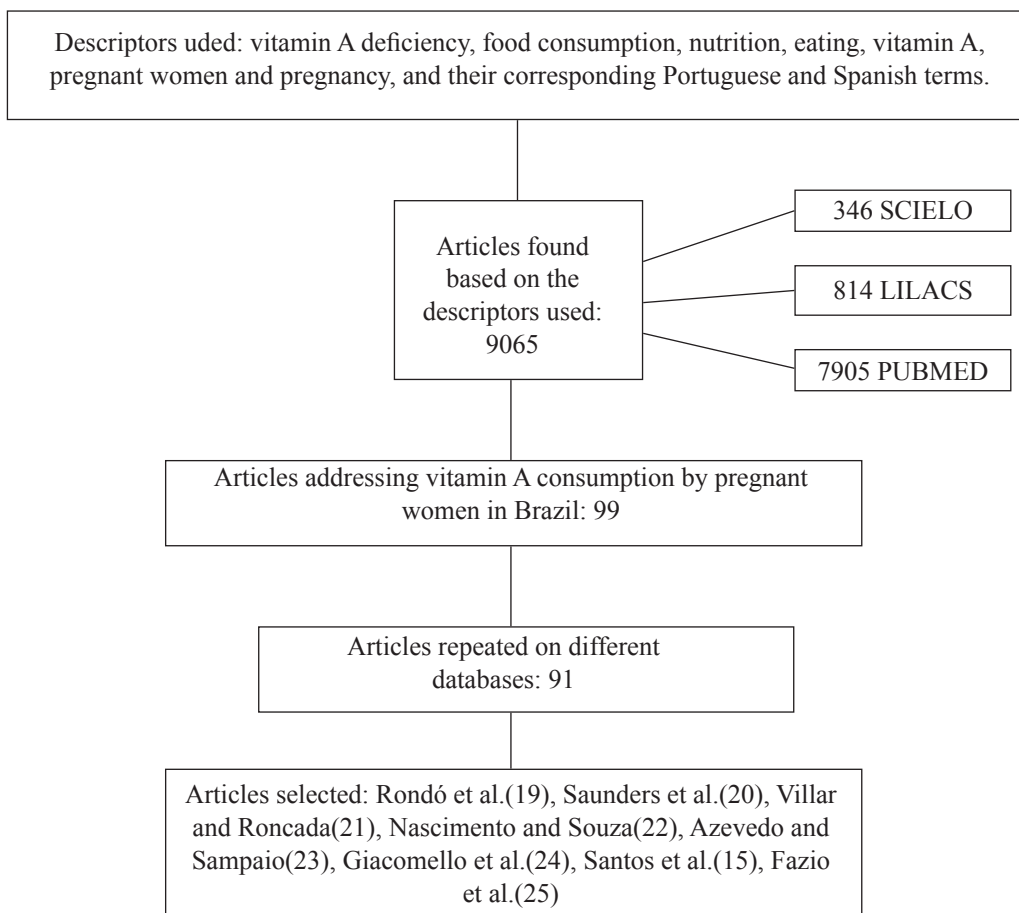


Figure 1 - Flowchart of selected articles.

DISCUSSION

Several methodologies have been employed to investigate food consumption in pregnant women, including the 24HR and the FFQ. However, it is noteworthy that, due to improper use and limitations of each method combined with the lack of validated and reproducible instruments, there are few studies that reliably reflect food consumption during pregnancy⁽²⁶⁾.

It is noteworthy that the majority (seven) of the studies that sought to assess vitamin A consumption by pregnant Brazilian women were cross-sectional; however, they presented a very long period for data collection, exceeding three months in five articles. If we consider the effect of seasonality on the availability of food sources of vitamin A in Brazil, the use of a short period for collecting data on food consumption gains even greater importance, since the availability of food may change considerably in different seasons of the year⁽²⁷⁾.

Unlike most studies, only one⁽²⁵⁾ conducted a retrospective study. Retrospective studies, also called recall or case-control studies, are cheaper and faster than the prospective studies; however, they are less reliable because although they take less time and resources, they rely on the respondents' ability to recall, leading to a less accurate quantification of risk factors and determining of temporal sequence between the exposure to the factor and the appearance of the outcome to be assessed⁽²⁸⁾.

With regard to the methods used to determine the sample of pregnant women of the studies analyzed, most samples were determined by convenience. Convenience samples are called nonrandom or nonprobability samples, which means that the elements that are part of it were selected by a value judgment, and not for reasons of statistical randomness. That is, the studies included individuals who were easier to contact⁽²⁹⁾, given that only two studies have conducted a sample calculation^(19,21).

The use of routine data derived from consultations in health services, whose results are extrapolated to the entire population with the nonrandom selection of members to make up the sample of the population survey, lead to suspect of selection bias in a survey⁽²⁹⁾.

Only one study⁽²⁴⁾ reported the losses, which were no more than 6% of the initial sample. It is noteworthy that the lack of a quantification of the losses may compromise the association estimates of studies, as well as the lack of control of some important confounders, which are capable of interfering negatively in the results⁽³⁰⁾.

Among the studies reviewed, six controlled the independent variables, which were mostly education, age, income, weight, height and body mass index (BMI). It is noteworthy that the independent variables are used to expose the health status of subgroups of the population, provide subsidies for causal explanations or hypotheses, which constitute the starting point for further studies, and define intervention priorities in order to influence the direction of prevention and control measures⁽²⁹⁾.

The independent variables presented as confounders by the articles^(19,20,23,25) include the education level of pregnant women, which can influence the reporting of consumption through the FFQ, and the less privileged socioeconomic status, which can lead to embarrassment and make pregnant women overestimate their consumption. In addition to these, potential factors included seasonality, eating habits and the non-application of food surveys in different trimesters of pregnancy. The latter is of utmost importance because the formation of fetal stores of vitamin A starts during the last trimester of pregnancy and requires - after birth - several months of proper intake to build its reserves^(31,32).

One of the articles pointed out as possible bias the fact that overweight pregnant women received nutrition counseling prior to data collection, which may have caused underreporting of food intake.

Many studies using dietary surveys do not consider important factors such as recall bias, particularly with regard to information collected retrospectively, as is the case of the 24HR and the FFQ. In addition, other factors may hinder the recording of food intake of individuals, such as the complexity of the diet plan, eating habits, quality of information, age, body image, the respondent's memory, beliefs, behavior, culture and socioeconomic status⁽³³⁾. It is essential to know the limitations of each method, as they are potential sources of bias. Therefore, properly conducted studies can provide accurate data on food consumption as long as researchers are well trained and interviewees are motivated^(17,26).

Before the publication of the Dietary Reference Intakes - DRI⁽³⁴⁾, the Recommended Dietary Allowance - RD⁽³⁵⁾

was used for the categorization of inadequate consumption both for individuals and for population studies. However, the current estimation method of appropriate reference for assessing inadequate nutrient intake is the EAR (Estimated Average Requirement), which is defined as the nutrient intake value that corresponds to the average estimated need for a particular life stage and gender. The EAR value of vitamin A for pregnant adults is 550 µgER, and for pregnant adolescents is 530 µgER⁽³⁶⁾.

Vitamin A consumption by pregnant women in the postpartum period was investigated through an unvalidated simplified version of the food frequency questionnaire referring to the usual consumption during the nine months of pregnancy⁽¹⁹⁾. The categorization of women into high, moderate and low risk for vitamin A intake deficiency was made based on RDA guidelines⁽³⁵⁾, which recommend the consumption of 800 µgER/day. The average intake of vitamin A was 487.31 µgER/day. Although the study concluded that the majority of women did not have a high risk for VAD, it suggested that the application of the food frequency questionnaire is not sufficient to assess the status of vitamin A, probably due to consumption variations.

Another study found a fluctuation of the average vitamin A content of the diets based on five different tables through the 24HR⁽²⁰⁾. The average values of vitamin A in the diets, based on the five tables, were: 1008.89 µgER⁽³⁷⁾; 1204.90 µgER⁽³⁸⁾; 1494.06 µgER⁽³⁹⁾; 793.02 µgER⁽⁴⁰⁾ and 908.97 µgER⁽⁴¹⁾. It was observed a large fluctuation of the average values of vitamin A - which were also above the 600 µgER/day intake recommendation suggested by the FAO⁽⁴²⁾ - used by the authors to assess dietary adequacy.

Although the aforementioned authors have used a rigorous methodology for the application of the recall, such as the use of portion sizes, illustrations of food portion sizes, and interviewer's training, the application of a single recall is not able to represent the usual food intake of an individual. Moreover, of all the limitations of this survey, the most worrying is that it does not provide a reliable estimate of nutrient absorption due to daily changes; additionally, when it is used in epidemiological studies, the ability to describe significant associations between diet and disease risk is considerably reduced⁽³³⁾.

It is also noteworthy that the identification and control of potential biases of the dietary survey could improve its reliability as an early and pre-pathological indicator of the nutritional status of vitamin A⁽²⁰⁾.

One of the selected studies⁽²¹⁾ assessed the consumption of vitamin A through a simplified dietary form consisting of a 24HR questionnaire (applied by a trained interviewer, but with no reports on the standardization of portion sizes) and the FFQ. Another study⁽²²⁾ assessed the energy value and

nutritional adequacy of dietary intake of pregnant women with previous overweight or overweight during pregnancy and found an adequate nutrient intake. The investigation of food consumption used only the 24HR and did not inform about the standardization of portion sizes or whether the interviewer was trained. The dietary recommendation used was the RDA⁽³⁵⁾, with a percentage of 132.43% of adequacy of vitamin A. However, it is believed that food consumption was underestimated by pregnant women, as they received nutrition counseling before data collections.

Food consumption by pregnant adolescents attending a public reference prenatal care service in Fortaleza was also assessed⁽²³⁾. The method used was the 24HR applied in three nonconsecutive days. There were no reports on the standardization of portion sizes the training of the team. It was observed that 58.2% of pregnant women had adequate vitamin A consumption according to the DRI⁽³⁴⁾, which recommends the intake of 770 µgER/day for pregnant adolescents. However, although the authors have reported on this recommendation, it can be seen through the analysis of the results that the reference actually used to estimate adequacy was the RDA⁽³⁵⁾, which recommends 800 µgRE/day.

A study of pregnant users of the SUS in Porto Alegre and Bento Gonçalves applied two recalls to those who were interviewed once and four to those who were interviewed twice⁽²⁴⁾. The recalls were applied using a standardized form and interviewers were trained. The study also used a validated food frequency questionnaire⁽⁴³⁾ addressing eighty foods. The recalls revealed an average vitamin A consumption of 927 µgER/day, and the frequency questionnaire showed an average of 1601 µgER/day. The authors observed that there was an overestimation of the intake of energy and other nutrients in the food frequency questionnaire.

The association of night blindness with nutritional variables in pregnant women was assessed⁽¹⁵⁾ through an unvalidated qualitative food frequency questionnaire composed of 23 foods. Because it was a qualitative questionnaire, it did not estimate the average intake of vitamin A; however, the authors observed a lower intake of vitamin A by pregnant women with night blindness.

Regarding the statistical analysis used in the articles reviewed, most of them (seven) described the statistical method used; only one⁽²²⁾ study did not identify the test for difference of means used and conducted an analysis of the results whose statistical method used was not reported.

Finally, it is noteworthy that the use of different food composition tables, some without adequate information on the content of regional foods, may have contributed to the wide variation in the average intake of vitamin A among

the reviewed studies. Thus, it is noted that there is a need for more rigorous investigations as to its methodological aspects in order to minimize potential sources of errors and biases through validated and reproducible instruments.

CONCLUSION

It is observed that studies that carefully assess the consumption of vitamin A by pregnant women in Brazil are still scarce, and the identification and control of potential biases of the dietary survey could improve the reliability of the data found.

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