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Effectiveness of a nutritional education intervention on anemia in pregnant women at the first level of care

Eficacia de una intervención educativa nutricional en la anemia de gestantes del primer nivel de atención

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ABSTRACT

Objective: To evaluate the impact of an educational intervention on factors associated with anemia in pregnant women at the first level of care. Methodology: The research corresponds to the applied, quasi-experimental type, which seeks to evaluate the impact of an educational intervention with follow-up in subsequent prenatal controls on the use of iron-rich foods, complementary to routine iron and folic acid supplementation. The variation in the consumption of iron-rich foods, hemoglobin level and anemia in pregnant women attended at P.S Gerardo González Villegas I-2 Tumbes, 2022 was evaluated prospectively. An experimental cohort of a sample of 200 cases and 100 controls was prospectively studied. Results: Before the educational intervention, there was similarity in age (14-42 years) and in urban and rural origin in pregnant women of cases and controls. With the educational intervention it was possible to improve the consumption of foods rich in iron in pregnant women, increase the level of hemoglobin and significantly decrease the incidence of anemia with an efficacy of 61.7% in the population of controls and cases non-intervened and 92.5% only in the population of intervened cases; also, the prevalence of anemia (p<0.05). Conclusions: The impact of the educational intervention developed was positive, because it managed to increase the cognitive level and practices of pregnant women for the prevention of anemia during pregnancy, evidencing changes in eating behavior, improving their nutrition and hemoglobin level, and significantly preventing anemia.

Key words: Food and nutrition education, ferropenic Anemia, iron deficiency, Pregnancy, Feeding behavior

RESUMEN

Objetivo. Evaluar el impacto de una intervención educativa sobre factores asociados a la anemia en las gestantes atendidas en el primer nivel de atención. Metodología. La investigación corresponde al tipo aplicada, cuasi experimental, que busca evaluar el impacto de una intervención educativa tipo charla educativa con seguimiento en controles prenatales posteriores, sobre el uso de alimentos ricos en hierro, complementario a la suplementación rutinaria de hierro y acido fólico. Se evaluá psoteriormente la variación en el consumo de alimentos ricos en hierro, el nivel de hemoglobina y la anemia en las gestantes atendidas en el P.S Gerardo González Villegas I-2 Tumbes, 2022. Se estudió prospectivamete una cohorte experimental de una muestra conformada por 200 casos y 100 controles. Resultados. En gestantes de casos y controles antes de la intervención educativa hubo similitud respecto a edad (14 a 42 años) y en la procedencia urbana y rural. Con la intervención educativa se logró mejorar el consumo de alimentos ricos en hierro en las gestantes, incrementar el nivel de hemoglobina y disminuir significativamente la incidencia de anemia, con una eficacia del 61,7% en la población de controles y casos no intervenidos y en el 92,5%, solo en la población de casos intervenida; también la prevalencia de anemia (p<0,05). Conclusiones. El impacto de la intervención educativa desarrollada fue positivo, porque consiguió incrementar el nivel cognitivo y prácticas de las gestantes para la prevención de la anemia durante el embarazo, evidenciándose cambios de comportamientos alimentarios, mejorando su nutrición y el nivel de hemoglobina, y previniendo la anemia significativamente.

Palabras clave. Educación alimentaria y nutricional, Anemia ferropénica, Embarazo, Conducta alimentaria

Introducción

It has been estimated that 36.8% (95%CI: 31.5%-42.4%) of pregnant women worldwide have iron deficiency anemia[1]; affecting mother and baby, and increasing maternal mortality, premature delivery, in-

fant mortality and low birth weight. According to the World Health Organization (WHO), every year mortality attributed to anemia in women of reproductive age is significant[2]. Antenatal iron and folic acid supplementation have been successful in reducing the prevalence of anemia; however, anemia still accounts for 20% of maternal deaths worldwide[3]. The use of iron-fortified condiments and food flavorings have not convincingly achieved a favorable effect[4].

In some places, pregnant women's knowledge of anemia and adherence to anemia prevention strategies are not encouraging, and better education and awareness programs on their diet are needed[5]. Interventions with folic acid and iron accompanied by health education are effective in reducing gestational anemia, but the level of evidence is still low, and the most effective setting should be evaluated: the home, the school or the health service[6]. Of the multiple risk factors for gestational anemia[7-10], many are modifiable with health education. Most interventions document the efficacy of oral or parenteral iron in the first trimester in preventing gestational anemia, with few studies on interventions to improve the variety and quality of the diet[2,11]. The hemoglobin level has high sensitivity for monitoring anemia in pregnant women [12,13].

In primary care, training health personnel in iron-containing diets to promote their use in pregnant women, together with interventions on social determinants (educational level), is likely to improve adherence to iron treatment and hemoglobin level[14]. In Peru, such adherence continues to be a problem, as well as incorporating dietary habits to consume foods that supply iron[15]. There are small effective trials of educational programs for learning about balanced nutrition with different results[16], and there are also factors that affect the consumption of iron-rich diets[17].

At the hospital level, educational activities in pregnant women improve the level of nutritional knowledge and hemoglobin level and decrease iron deficiency anemia[18]. In Peru and in many other places, anemia intervention studies emphasize the pharmacological use of iron and vitamin supplements[19]. However, the impact of additionally promoting the consumption of iron-containing foods on hemoglobin levels and anemia in pregnant women, especially at the first level of care in the north of our country, has been little evaluated. Therefore, in this scenario, we will evaluate the impact of an educational intervention to improve nutritional habits of iron-rich food consumption in pregnant women, making them aware of their hemoglobin levels to prevent anemia.

Methods

The present is a nonrandomized parallel population-based trial applying an educational intervention without random assignment to small groups of 4 to 5 pregnant women who attended their usual prenatal care visits daily, until a probability sample of 200 (95% CI) pregnant women was completed. As controls, 100 non-intervened pregnant women were observed in another similar health facility. We enrolled pregnant women between the first and third trimesters of pregnancy who were from the jurisdiction and who continued their controls at the health facility. Those with disabilities, those who did not wish to participate, those who migrated to other places and those whose medical history was not complete were excluded. The application of surveys and data collection was carried out in the clinic for comprehensive care of pregnant women, while the educational intervention for the cases took place in the waiting room. A population-based survey of 23 questions was applied, validated by experts and with a reliability of Crombach's alpha 0.8, and complementary data were obtained from the clinical histories.

Locally available, accessible and inexpensive iron-rich foods were identified (Table 1). An educational session of 30-40 minutes was given to inform the mothers about anemia and its context in pregnancy, the importance of taking iron supplements and the added value of consuming locally available iron-rich foods of animal (chicken blood and liver, beef spleen and fish) and vegetable (spinach and lentils) origin, using flip charts. The participatory technique included presentation, analysis and closing. At the end of each session, illustrative leaflets were handed out with diets based on selected iron-rich foods to be included in their meals. During the following prenatal consultations, the pregnant women under study were reminded of the importance of consuming iron-rich foods of animal and vegetable origin in their daily diet, as well as the importance of the use of iron and folic acid.

Table 1. Average iron content in 100 g of foods promoted to pregnant women of animal and vegetable origin.

Food (100 g)	Iron mg	Recommended daily portions	Approximate cost of 100 g in nuevos soles *	Availability in local markets **
Chicken blood	29,5	5 tablespoons	S/ 1,00	+++
Beef spleen	28,7	5 tablespoons	S/ 1,00	+++
Chicken liver	8,5	5 tablespoons	S/ 1,00	++++
Fish	3	5 tablespoons	S/ 2,50	++++
Lentil	1,7	Half cup	S/ 1,00	++++
Spinach	3	2 cups	S/ 1,00	+++

** Peruvian nuevos soles*
*** Markets in the place where the pregnant women in the study reside.*
Source: INS/CENAN. Peruvian Food Composition Table[20]

In the cases, in the first evaluation and then at around 13 weeks, a survey was applied to evaluate the same variables and the level of hemoglobin in the blood was recorded. The controls only had their age and hemoglobin level recorded in the first trimester, second trimester and third trimester of pregnancy.

The variables measured were the age of the pregnant women and the gestational age classified as I trimester between 1-12 weeks, II trimester between 13-26 weeks and III trimester, 27 weeks or more. According to the hemoglobin level, anemia was considered to be less than 11 mg% for the first and third trimesters and less than 10.5 mg% for the second trimester. Anemia was classified as mild when Hb was between 10-10.9 (I and III trimesters) and 9.5-10.4 mg% (II trimester), moderate between 7.0-9.9 mg% (I and III trimesters) and between 7.0-9.4 mg% (II trimester) and severe <7 mg%[13,21,22].

The population was described with measures of central tendency and frequency tables. Dietary habits were estimated according to the intensity of consumption of iron-rich foods (ICIRF) obtained by the formula ICIRF = (times/day) X (times/week) X (times/month) X (serving size) X (personal tendency), resulting in a numerical value representing the magnitude of consumption. The effect of the educational intervention was evaluated by comparing the use of iron-rich foods, hemoglobin concentration and anemia rate of the pregnant women before and after the intervention.

No changes were necessary in the results of the trial after it began. Hypotheses were tested for 95% confidence intervals with measures of central tendency based on the normality of quantitative variables. Comparisons of measurements were performed with chi-square, Mann Whitney U or Kruskal Wallis statistics. Risks were estimated using relative risks and their indicators of clinical significance to estimate clinical associations.

The study was approved by the Research Ethics Committee of the Faculty of Health Sciences of the National University of Piura as a quasi-experimental population-based trial of very low risk, because it was conducted to promote the use of diets that can be consumed by any person on a regular basis and without adverse effects. Informed consent was given to the pregnant women before the intervention, and the privacy and confidentiality of the data were protected.

Results

The cases were 200 pregnant women from the Gerardo Gonzales Villegas Health Post and the controls were 100 pregnant women from the Pampa Grande Health Center, both located in the Tumbes region. Before the intervention, cases and controls were similar according to quintiles, gestational age and anemia rate in the second and third trimester of pregnancy (p<0.05).

Among cases, 29 (14.5%) were enrolled as a cohort for two assessments in the first trimester of pregnancy, 162 (81%) in the second and 9 (4.5%) in the third, with cases having a median age of 25 years (interquartile interval [IQi] 21-30; minimum 11, maximum 42 years) and controls having a median age of 26 years (IQi 20-32; minimum 14, maximum 43 years) (Mann Whitney U, p>0.05). According to gestational age, cases had a median of 18 weeks (IQi: 15-21; minimum 6, maximum 27 weeks) and controls a median of 18 weeks (IQi: 15-21; minimum 8, maximum 28 weeks) (Mann Whitney U, p>0.05).

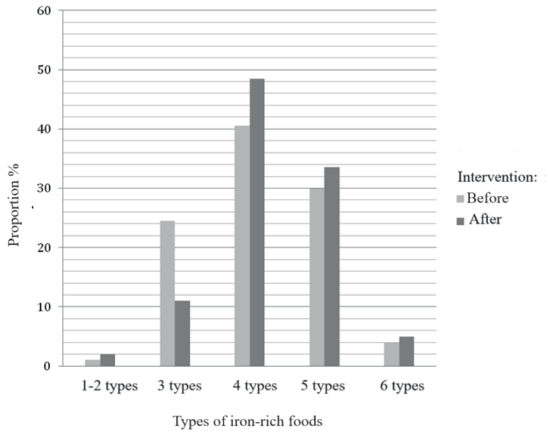
Hemoglobin concentration had a median of 12.0 mg% (IQi: 11.5-12.8; Min. 9.6 and Max. 14.5 mg%) for cases, and 11.8 (IQi: 11.0-12.4; Min. 9.1 and Max. 14.3 mg%) in controls (Mann Whitney U, p<0.01). The median hemoglobin level tended to decrease from I to III trimester of pregnancy in both health facilities (significantly in controls and non-significantly in cases (Wilcoxon signed-rank test: Z= -3.85, p<0.001 and p>0.05, respectively). The prevalence rate of anemia was 4.5% in cases and 7.0% in controls (chi-square 0.83, p>0.05).

Before the intervention, in cases the intensity of consumption of iron-rich foods (ICIRF) was found in lentil with a median of 96 (IQi: 36-216; min and max 1 and 4,725), with fish a median of 96 (IQi 36-288; min and max 0 and 2,520), with vegetables a median of 64 (IQi 36-64; min and max 0 and 5,292), liver a median of 7 (IQi 0-42; min and max 0 and 972), spleen a median of 0 (IQi 0-0; min and max 0 and 192) and blood a median of 0 (IQi 0-4; min and max 0 and 432).

Within a median of 13 weeks (IQi: 13-15; Min. 6, Max. 21 weeks) the intervened cases were evaluated, finding a highly significant increase in the intensity of consumption of iron-rich foods (ICIRF); with average ranges of the increase of fish ICIRF by 4.5, lentil 4.5, vegetables 3.5, liver 3.2, blood 2.8 and spleen 2.5 (Friedman test: chi-square 258.3, p-value<0.01). The proportion of use of combinations of 4 or more types of iron-rich foods also increased, as well as the decrease in the consumption of 3 types of foods (chi2=12.9, p<0.05) (Figure 1).

In all the intervened cases, the hemoglobin level between the first and second evaluation showed a non-significant increase in the median and mean ranges of the hemoglobin level (Wilcoxon test of the ranges with sign Z=-1.89, p>0.05). In the 29 pregnant women enrolled in the cohort in the first trimester (who underwent intervention after the first hemoglobin assessment), hemoglobin increased significantly in the second assessment (Wilcoxon test of ranges with a Z-sign = -3.77, p<0.001), whereas, in the 162 pregnant women intervened in the second trimester, hemoglobin increased non-significantly (Wilcoxon test of ranges with a Z-sign = -0.64, p>0.05). In the third trimester of pregnancy, hemoglobin also increased non-significantly (Wilcoxon signed ranks test with a Z-sign = -1.47, p> 0.05).

Figure 1. Proportion of consumption of iron-rich foods types in pregnant women (cases) before and after the educational intervention, 2022.

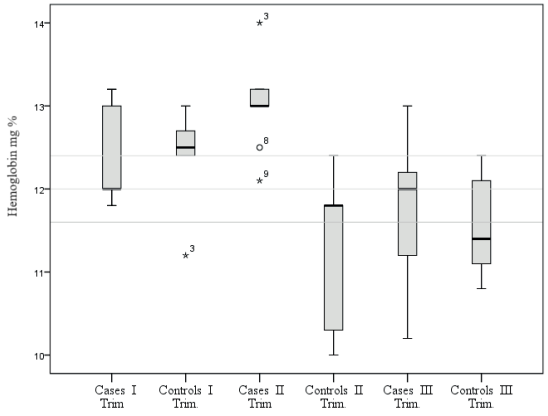


Source: Data collection form

Also, in all three groups there was a similar positive variation in the increase in hemoglobin after the intervention (Kruskal-Wallis 2.34, p>0.05) (Figure 2).

In 9 first trimester pregnant women with anemia before the educational intervention, the median hemoglobin increased significantly from 10.3 (IQi: 10.0-10.3; Min. 9.6 and Max. 10.9 mg%) to 10.8 (IQi: 10.5-10.9; Min. 10.2 and Max. 12.2 mg%) after the educational intervention (Wilcoxon test p<0.05). In 6 anemic pregnant women in the second trimester of pregnancy, their hemoglobin increased highly significantly from a median of 10.2 (IQi: 10.0-10.3; Min. 10.0 and Max. 10.3 mg%) to 10.7 (IQi: 10.5-10.9; Min. 10.3 and Max. 12.0 mg%) after the educational intervention (Wilcoxon test, p<0.01), while in the 3 anemic pregnant women captured in the third trimester

Figure 2. Comparison of median hemoglobin levels by trimester of pregnancy in the cohort of postintervention cases and controls, 2022.



Trim= trimester
Source: Data collection form

the median hemoglobin increased from 10.6 to 10.9, but not significantly (Wilcoxon test, $p>0.05$).

When comparing the variation in intensity of consumption of iron-rich foods (ICIRF) [increase, no variation or decrease] with those with variation in hemoglobin level [increase, no variation or decrease], a significant association was found between the increase in intensity of fish consumption (fish ICIRF) and the increase in hemoglobin (chi-square 10.9, *p*-value=0.027). There was also a non-significant increase consuming lentils, liver, spleen and blood sausage ($p>0.05$).

Likewise, when comparing the variation in the intensity of consumption of iron-rich foods (ICIRF) [increase, no variation, decrease] with those who did and did not have anemia, a significant association was found between the increase in the intensity of fish and vegetable consumption (fish or vegetable ICIRF) and not having anemia (chi-square 6.47, *p*-value=0.039; chi-square 9.45, *p*-value=0.01, respectively); there was also a non-significant tendency not to have anemia by consuming lentils, liver, spleen and blood sausage ($p>0.05$). In addition, for the effect of the educational intervention, the increase in the use of combinations of iron-rich food types (ICARH of combinations) was highly significantly related to increases in the median hemoglobin level (Kruskal-Wallis test =23.5, $p<0.01$).

When comparing the prevalence rate of anemia before and after the educational intervention, there was no significant variation in the prevalence rate of anemia in the cases ($p>0.05$). However, when comparing the prevalence of anemia by trimester of pregnancy, in the second trimester there were no cases of anemia post-intervention, and in the third trimester there was a lower rate of anemia post-intervention. Also, postintervention there was a higher rate of anemia in the controls compared to the cases (Table 2).

Between the first evaluation and the second post-intervention evaluation there was a highly significant decrease with much lower incidence rate of anemia in the cases of pregnant women, and also when compared to the controls ($p<0.001$) (Table 3). Thus, the educational intervention had a highly significant protective effect in cases relative to controls, with a reduction in the incidence of anemia with moderate efficacy in the population and high efficacy in intervened cases (Table 4).

Discussion

This study shows a significant increase in the consumption of a variety of iron-rich foods in the diet of pregnant women (in addition to iron and folic acid supplementation), an increase in hemoglobin levels and a decrease in anemia rates in pregnant women after an educational intervention with follow-up through prenatal visits. The best results, both in hemoglobin levels and in the lower rate of anemia, were evidenced with the intervention during the first trimester compared to the second and third trimesters of pregnancy.

It is evident that the pregnant women were unaware of the role of a diet enriched with iron-rich foods to prevent anemia in pregnancy. The

Table 2. Comparison of anemia prevalence rates between pregnant women and controls, 2022.

Pregnancy trimester	Anemia before (cases) n=200		Total before	Rate %	Anemia later (cases) n=200		Total later	Rate %	*p* value
	No	Yes			No	Yes			
I	29	0	29	0	0	0	0	0	--
II	156	6	162	3.7	35	0	35	0	--
III	6	3	9	33.3	150	15	165	9.1	0.038 *
Total	191	9	200	4.5	185	15	200	7.5	0.23 **
	Anemia in cases		Total cases		Anemia in controls		Total controls		
I	0	0	0	0	93	7	100	7	--
II	35	0	35	0	90	10	100	10	--
III	150	15	165	9.1	78	22	100	22	0.008 **
Total	185	15	200	7.5	261	39	300	13	0.026 *

** Exact Mid-p (1-tail)*
*** Exact Mid-p (2-tail)*
Source: Data collection form

Table 3. Comparison of incidence rates of anemia in the interventional cohort of pregnant women and controls, 2022.

Educational intervention	Anemia					*p* value
	Yes	Rate x1000	No	Rate x1000	Total	
Yes	3	15.0	197	985.0	200	<0.0001 *
No	20	200.0	80	800.0	100	
Grand total	23	76.7	277	923.3	300	

** Yates corrected Chi-square: 29.7, maximum likelihood odds ratio estimator*
Source: Data collection form

Table 4. Risk-based estimator* and 95% confidence intervals for anemia incidence rate in pregnant women in the case-control cohort and comparison with the control cohort, 2022.

Point calculation		Trust limits	
Type	Value	Lower - Upper	Type
Risk in exposed	1.5%	0.3 - 4.5	Taylor Series
Risk in unexposed	20%	13.3 - 28.9	Taylor Series
Total risk	7.7%	51 – 11.3	Taylor Series
Risk ratio	0.08	0.02 – 0.3	Taylor Series
Risk difference (RAR) (Attributable risk)	-18.5%	-26.5 - -10.5	Taylor Series **
Fraction preventable in population (fpe); RRR(E)	61.7%	32.2 - 50	
Fraction preventable in exposed (fpe); RRR(E)	92.5%	75.4 - 97.7	
Number needed to treat in population: NNT(P)=1/RRR(P)	1.6	2 - 3.1	
Number needed to treat in exposed: NNT(E)=1/RRR(E)	1.1	1.0 – 1.3	

** Maximum likelihood estimator for odds ratio*
*** Estimation of confidence intervals of a rate with variance estimation methods for nonlinear functions (Taylor series) https://rppoblacion.uaemex.mx/article/download/8609/7318/*
Source: Table 3

increase in the cognitive level generated behavioral changes to improve their nutrition in the cases, compared to a non-intervened control group, in whom hemoglobin levels decreased and the rate of anemia increased.

There is social relevance, because educational interventions are easy to apply and low cost, contributing positively to the prevention of anemia during pregnancy. Similar to some models with impact on improving knowledge and dietary practices[23], the significant increase in knowledge leads to change in attitudes, contributes to perceived behavioral control, subjective norms and nutritional behavioral intention[24,18].

Something similar was the experience of sustained online education in pregnant women during the pandemic by COVID-19[25,26]. There are foods such as liver, spleen and blood sausage that tend to be scarce in that city, and this may explain their non-significant contribution in the increase of hemoglobin, unlike fish and vegetables that contribute significantly and are more accessible. The COVID-19 pandemic situation, which forced the application of face-to-face educational sessions in small groups of 3-5 pregnant women in an open and ventilated place, has facilitated the transmission of knowledge by the health professional through greater interaction, although some educational models such as HAPA improve behavioral intention and action planning for better nutritional behavior, but no significant favorable outcomes are seen in malnourished pregnant women[27]. Anemia should be approached from a pedagogical point of view and not only from the medical context, encouraging self-regulation of behavior through active participation in health care, reinforcing the transmission of knowledge[28,29]. Therefore, pregnant women used what they had learned and incorporated into their regular diet foods rich in iron available in their locality, as did other population groups[30].

Among the weaknesses of this study is that it is quasi-experimental without randomization of participants, it applies only two hemoglobin assessments within 13 weeks before and after the intervention, without covering the outcome of hemoglobin throughout the pregnancy, without control of intervening variables such as adherence to the use of iron[14], cultural acceptability and accessibility to iron-rich foods.

The strengths of the study include a probabilistic sample in terms of the size of the control and case groups, the use of a valid and reliable data collection instrument, the educational session with a small number of pregnant women[3-5] and its benefits, the follow-up and reinforcement of the use of the diet enriched with iron-rich foods in the area in subsequent prenatal visits, and the availability in the city of iron-rich foods accessible to pregnant women.

It is recommended to apply trials of population-based educational interventions using different educational methodologies to identify the most

effective, randomized cohorts of patients during the entire pregnancy outcome, complemented with follow-up through educational home visits, demonstrations, etc., especially taking advantage of the first contact with the patient as early as possible in the pregnancy and preferably in the first trimester of pregnancy.

It is concluded that educational interventions to promote in small groups the consumption of iron-rich foods available and accessible to pregnant women, preferably applied in the first trimester of pregnancy with follow-up in all prenatal visits, are effective in increasing the consumption of iron-rich foods, the level of hemoglobin and reducing anemia in pregnancy compared to non-interventional controls. It is recommended to routinely implement this type of educational interventions from the first contact, involving health facility personnel.

In addition, the health system should facilitate information for access to and consumption of local foods with high iron content, as well as the possibility of supplementing diets with iron-rich foods for pregnant women in places where iron-rich foods are scarce.

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