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An analysis of micronutrient consumption of mothers using the Demographic and Health Surveys of the Dominican Republic

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Surveys of the Dominican Republic

by

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ABSTRACT

BACKGROUND: Micronutrient deficiency (vitamin A, iron, and iodine) is highly prevalent in the Dominican Republic as indicated by food consumption patterns, which are not reflective of consumption of micronutrient dense foods. Previous studies (Neves, Ramalho, Padilha, & Saunders, 2014) have shown that nutrition education offered by prenatal providers has a positive impact on nutrition outcomes in mothers and children. Little research exists which examines the difference in micronutrient consumption among mothers in the Dominican Republic. The aim of this study was to determine differences in micronutrient rich food consumption of mothers in the Dominican Republic based on type of prenatal provider (General practitioner, Obstetrics/gynecology (OBGYN) or no Provider).

METHODS: The 2007 Dominican Republic DHS dataset was employed for this study. Odds ratios from multivariate logistic regression analyses were used to determine association between sources of prenatal service and micronutrient food intake. Statistical adjustments were made for residence, wealth index, education, marital status, smoking age and number children ever had.

RESULTS: Compared with mothers who did not utilize any of the prenatal services, mothers who sought care from General practitioners and OBGYN had increased odds of consuming vitamin A, iodine and iron micronutrient rich foods, adjusting for residence, wealth index, education, marital status, smoking age and mother's total number of children. However, the associations were not statistically significant. Compared to mothers who did not use prenatal care, mothers who used the services of General practitioners and OB/GYNs had greater odds, (OR=1.09; 95% CI:0.85-1.41) and (OR=1.29; 95% CI:1.01-1.65) respectively, of consuming at least one micronutrient food. Compared to mothers who did not use prenatal care, mothers who used the services of General practitioners (OR=1.31; 95% CI:1.00-1.70) and OB/GYNs and (OR=1.36; 95% CI:1.05-1.75), had greater odds of consuming at least two micronutrient foods. The corresponding odds ratios for consuming all three micronutrients for mothers using the services of General practitioners and OBGYN were 1.48 (95% CI=0.80-2.74) and 1.51 (95% CI=0.84-2.74), respectively.

DISCUSSION: Improvements and access to programs providing nutrition education for prenatal care providers, and medical and nutrition assistance to poor mothers may help to increase micronutrient rich food consumption in the Dominican Republic.

KEY WORDS: micronutrient, diet, maternal, Dominican Republic

An analysis of micronutrient consumption of mothers using the Demographic and Health Surveys of the Dominican Republic

According to the World Health Organization, 45% of all child deaths worldwide are linked to malnutrition (WHO, n.d), a condition that occurs as a result of deficit of nutrients such as calories, protein, vitamins or minerals. When malnutrition occurs during pregnancy or during the first years of life, it can result in stunting, underweight, wasting, lifelong developmental delays, disability or death (Caulfield et al., 2006). In addition, it puts children at a higher risk of experiencing infectious illnesses like diarrhea, pneumonia and malaria (WHO, n.d.). Additional studies on the long-term effects of stunting have shown associated negative effects on school achievement, economic productivity and maternal reproductive outcomes into adulthood (Dewey & Begum, 2011).

The type of malnutrition that is specific to nutrients only found in food is called micronutrient deficiency, and it can have a lifelong negative impact on an individual's overall health. On a global scale the three most common types of micronutrient deficiencies are vitamin A, iodine, and iron. Because micronutrients are obtained only through diet, these deficiencies tend to disproportionately affect those who are food insecure. The first most prevalent is Vitamin A deficiency (VAD) which increases the risk of disease and death from severe infections, can result in anemia in women and children, it is the leading cause of preventable blindness in children, and causes night blindness in pregnant women (WHO, 2009). The other leading micronutrient deficiency, iodine deficiency, has been linked to mental retardation, hypothyroidism, goiter, and cretinism (National Research Council, 2001). Lastly, iron deficiency is linked to decreased work performance, negative pregnancy outcomes, and cognitive impairments (National Research Council, 2001). All three of these micronutrient deficiencies are prevalent in the Dominican Republic. According to The Food and Agriculture Organization, rates of micronutrient deficiency in the Dominican Republic were still high in the year 2003. At the national level, 19% of all school age children suffered from stunting, 5% suffered from the micronutrient deficiency goiter (due to iodine deficiency), 23% suffered from low serum retinol (low level of vitamin A), and 31% of children aged 1-14 years suffered from anemia (due to iron deficiency) with a higher prevalence seen in urban areas (FAO, 2003).

Consumption of certain foods is necessary to maintain adequate levels of micronutrients in the body however the pattern of consumption in the Dominican Republic suggests a lack of micronutrient rich food intake. According to FAO (2003) the consumption of cereals and fats (animal and vegetable) has increased, and starchy tubers, fruits and vegetables have decreased. Specifically, rice and sugar were listed as the top two most available foods for consumption in 2011 (FAOSTATS, 2014) and following that were vegetable oils and wheat products. At the bottom of the list was chicken followed by fruits and then milk. This data indicates that the food available to the population tends to be shelf-stable carbohydrate and fat dense foods.

The introduction of nutrition education for patients during prenatal visits and the education of prenatal healthcare providers could be an effective approach to decrease micronutrient deficiencies in mothers and their children. In a study on prenatal nutritional care and the occurrence of night blindness, Neves et al (2014) conducted two separate cross sectional studies of postpartum and pregnant women in a public maternity hospital in Rio de Janeiro. Results indicated a significant decrease in the prevalence of night blindnes for mothers assigned to the prenatal nutrition assistance treatment group with a nutritionist when compared to the control group which did not receive any nutrition education. Given the success of education with mothers, a healthcare worker's involvement in nutrition education may also improve health outcomes of their children. Another review by Sunguya et al (2013) examined nutrition training of healthcare workers and its effects on child feeding frequency, caloric intake, and dietary diversity for children between the ages of six months and two years. Results of the study showed that nutrition training of healthcare workers improved daily caloric intake, and frequency of feeding of children in their care. Additional improvements in dietary diversity, an indicator of micronutrient adequacy in pregnant women (Ali, Thaver & Khan, 2014), were seen in trials which took place in India, Brazil, Pakistan, Peru and China. These studies show that given the proper information healthcare workers can influence the diets of new or expectant mothers resulting in improved health outcomes in their children.

According to the CDC's Global Health Initiative (GHI) for the Dominican Republic (2015), the Dominican Republic has a wide-ranging infrastructure with extensive access to antenatal care, which is able to reach even very isolated areas of the country. The Dominican Republic has the lowest rate of absence of prenatal care use (1.5%) when compared to other Latin American countries (Souza et al, 2007). It possesses over 1,100 primary health care centers, 200 hospitals, and a workforce of over 14,00 physicians for a population of 10.4 million. In addition there is a subsidized insurance program with over two million people enrolled, which has decreased out of pocket costs and increased access to even the poorest populations. Due to their infrastructure and subsidized insurance program, Dominican Republic is of certain interest when compared to other Latin American countries (LAC). However, due to the poor quality of health care, the benefits of the framework are almost entirely mitigated. The results of poor quality of care can be seen in the high mortality rate among mothers and children (92 maternal deaths per 100,000 live births in the Dominican Republic from 2011 to 2015). Because of the high maternal mortality and because of women's central role to the health of families and communities, it is a core objective of the GHI to improve the health of women and girls. It is a specific concern to address the quality of services that women and girls are receiving by focusing on building and strengthening integrated health services and encouraging the utilization of healthy behaviors among the population. In order to accomplish improved quality of care for women and girls, health care providers must have the necessary tools and training. It is possible that implementation of an intervention similar to Sunguya et al (2014), in which healthcare providers were trained on nutrition education for pregnant mothers, could cause a significant decrease in micronutrient deficiencies in both mothers and their children.

Given the existing healthcare framework in the Dominican Republic nutrition education interventions could provide an enormous opportunity for improvement in nutrition and general health outcomes for mothers and their children. The purpose of this study was to compare self-reported micronutrient rich food consumption of women in the Dominican Republic who received (1) prenatal care with a general practitioner (2) prenatal care with an OBGYN or (3) care from anyone other than an OBGYN or general practitioners (from here on called "neither"). Through this analysis of DHS data, the aim was to identify differences in micronutrient rich food consumption by healthcare delivery and maternal behaviors. It was believed that mothers who received prenatal care through an OBGYN or general practitioner would show increased odds of micronutrient rich food consumption when compared to those who did not receive either type of prenatal care.

METHODS

Data Source

The 2007 Dominican Republic Demographic and Health Survey (DHS) dataset was used for this study. Authorization to use the dataset was obtained from the Georgia State University Institutional Review Board. DHS is completed every five years with a sample size ranging from five thousand to thirty thousand households. The DHS uses a two-stage probability sample design where 300 to 500 clusters are selected and then 20 to 30 households in each cluster are randomly selected for interviews. Once households are identified, the local data collection staffs are trained on data collection procedures.

The DHS maintains high data quality through out the survey process, for example field editors verifies responses on the questionnaires and assists collectors in returning to the interviewee to gain clarification or corrections. Interviews are also observed throughout the survey process by senior survey staff to ensure data quality.

Study Population

The population of interest for this study included mothers in the Dominican Republic who participated in the 24-hour food recall section of the DHS survey. As seen in Figure 1, the total sample size is 5,030 mothers.

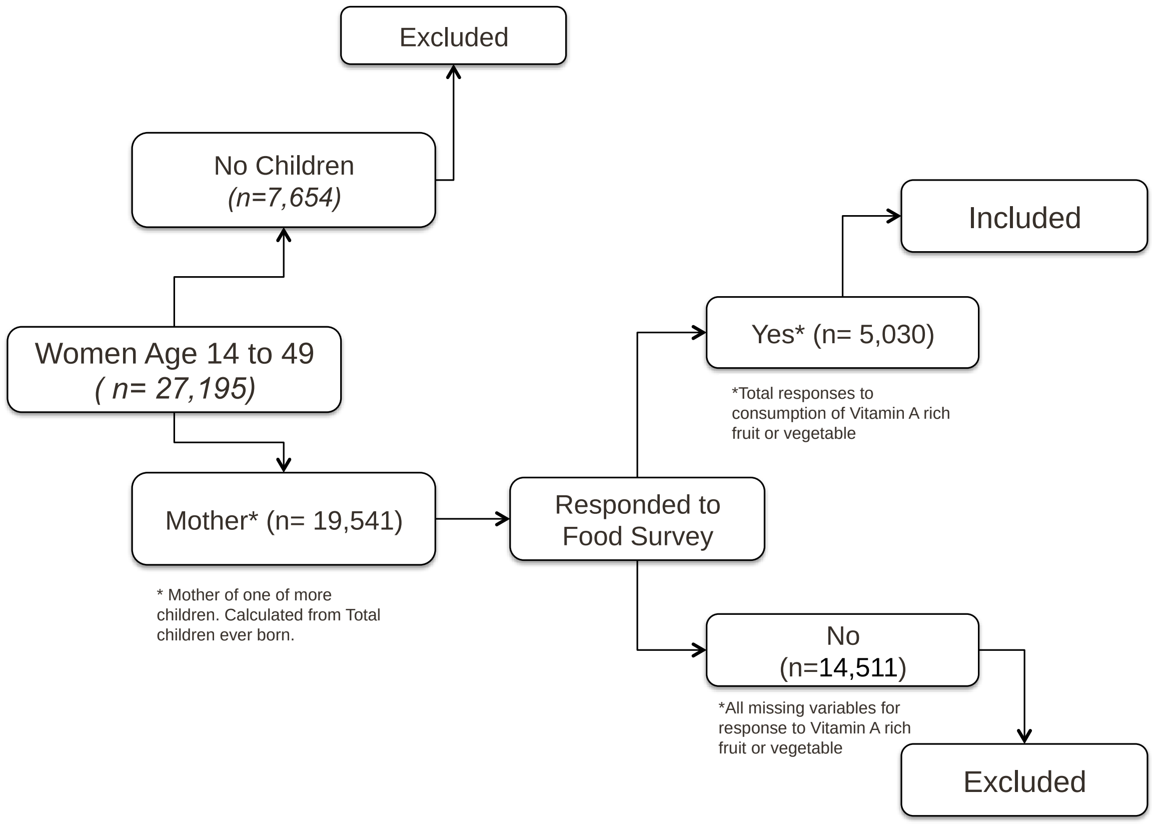

Figure 1. Sample selection flow chart for women of the Dominican Republic who were mothers and participated in the 24-hour food recall section of the 2007 DHS survey.

Design and Procedure

Recodes

Current age (V012) was recorded in years and was not recoded for this analysis. Defacto place of residence (V134) is the type of place in which the respondent completed the interview. Defacto place of residence had four possible responses: urban areas/capital cities (population > 1 million), small cities (population > 50,000), towns (other urban areas), and countryside (all rural areas), and it was not recoded. Wealth index (V190) is an alternate to household income and did not undergo any recoding. Highest education level attended (V106) was divided into the following categories: no education, primary, secondary and higher. Currently married was renamed from variable V502 in which respondents had three options, currently, never or formerly married. The variable "Does not smoke (V463Z" was renamed "Non-smoker" and did not under go any recoding. Total number of children ever born (V201) did not get recoded for this analysis.

The following variables came from the DHS twenty-four hour food recall portion of the DHS. A new variable, Consumption of vitamin A rich foods, was recoded into yes or no from the two variables Mother had pumpkin, carrots, squash (yellow or orange inside)(V472I) and/or Mother had mangoes, papaya, other vitamin A fruits (V472K). For the purpose of this study the focus was on vitamin A carotenoids in order to avoid confounding with consumption of meat products which both contain lesser amounts of iron and iodine. Consumption of iodine rich foods was renamed from the variable Mother had fish or shellfish (V472N). Marine fish, shellfish and foods which are grown in iodide-rich soils are food sources with high levels of iodine (National Research Council, 2001), however for the purposes of this study only marine fish and shellfish were considered a source of consumption due to possible confounding with consumption of fruits and vegetables which are considered vitamin A and iron rich. The new variable named Consumption of iron rich foods was recoded into yes or no from the two variables Mother had meat (beef, pork, lamb, chicken, etc) (V472H) and/or Mother had liver, heart, other organs (V472M). For the purpose of this study this variable concentrated on heme-iron sources (animal) because they are more bioavailable than plant based non-heme iron (National Research Council, 2001). Although seafood is considered a source of iron, it is not included in this study to decrease confounding results with consumption of iodine dense foods.

Dependent Variables

There were six dependent variables for this study: Consumption of (a) Vitamin A micronutrient rich foods, (b) iodine rich foods, (c) iron-rich foods, (d) at least one micronutrient rich food, (e) 2 or more micronutrient rich foods and (f) consumption of all 3 micronutrient rich foods.

Main Independent Variables

The main independent variable for this study was maternal source of prenatal care. Sources of prenatal care were based on the most recent birth as reported by mothers. From the household data set the variable M2A-N (type of person who gave prenatal care to respondent before the birth of their youngest child) was recoded into the three categories: General Practitioner, OBGYN and Neither. Neither category included other sources of prenatal care such as nurse/midwife, doctor of other specialty, doctor respondent does not know, traditional birth attendant, other response, and no one.

Other Independent Variables

The following independent variables were included in this study: maternal current age, defacto place of residence, wealth index score, highest level of education attended, birth, total number of children ever born.

Statistical Analysis

Version 20 of IBM's Statistical Package for the Social Sciences (SPSS) was utilized to complete the analysis. One-Way Analysis of Variance (ANOVA) and Pearson's Chi-square tests were used to compare continuous and categorical variables respectively, across sources of prenatal care. Odds ratios from logistic regression analyses were used to determine odds of vitamin A rich, iodine rich, iron rich food intake, consuming at least one micronutrient rich food, two micronutrient rich foods, and all three micronutrient rich foods. In the logistic regression models, we compared odds of micronutrient rich food consumption by comparing women receiving prenatal care from General Practitioner, OBGYN against women who receive care from other than these sources. In all analyses, statistical adjustments were made for defacto place of residence, wealth index, highest education level, marriage status, smoking, current age and total children ever born.

RESULTS

Descriptive Analysis

The following tables give an overview of socio-demographics and maternal characteristics of all mothers that have a response for the recoded variable, consumed vitamin A rich food.

Table 1. *Socio-demographic characteristics of mothers stratified by type of prenatal care.*

I. Socio- demographic	Total	Neither	GP	OBGYN	P-value
Sample size (n%)	5030	446 (8.4)	1336 (25.2)	3248 (61.2)	
Current Age in years(SD)	25.6 (6.1)	25.5 (6.6)	25.0 (6.3)	25.9 (6.0)	<.001*
De facto place of residence (n%)					<.001*
Capital, Large city:	383	23 (6.0)	63 (16.4)	297 (77.5)	
Small city:	1016	70 (6.9)	163 (16.0)	783 (77.1)	
Town:	1428	95 (6.7)	400 (28.0)	933 (65.3)	
Countryside:	2203	258 (11.7)	710 (32.2)	1235 (56.1)	
Wealth index (n%)					<.001*
Poorest:	1843	279 (15.1)	713 (38.7)	851 (46.2)	
Poorer:	1151	86 (7.5)	324 (28.1)	741 (64.4)	
Middle:	888	44 (5.0)	162 (18.2)	682 (76.8)	
Richer:	697	24 (3.4)	105 (15.1)	568 (81.5)	
Richest:	451	13 (2.9)	32 (7.1)	406 (90.0)	
Highest education level (n%)					<.001*
None:	289	67 (23.2)	119 (41.2)	103 (35.6)	
Primary:	2116	261 (12.3)	727 (34.4)	1128 (53.3)	
Secondary:	1855	97 (5.2)	404 (21.8)	1354 (73.0)	
Higher:	770	21 (2.7)	86 (11.2)	663 (86.1)	

As shown in Table 1, the current age of mothers differed significantly by type of prenatal care F (2, 5030) =10.23, p <. 001). Mean age for all mothers included in the analysis was 25.6 years (SD= 6.11). Mothers who received prenatal care with OBGYNs were older (M=25.9, SD= 6.0) than those who used a general practitioner (M=25.0, SD=6.3), or neither (M=25.5, SD=6.6). For all Defacto place of residence prenatal care with an OBGYN was reported more frequently than from a general practitioner, or neither. Prenatal care differed significantly by de facto place of residence with a X^2 (6, N = 5030) = 180.3, p < .001. For all wealth index groups prenatal care with an OBGYN was reported more frequently than general practitioner, and neither. A comparison of prenatal care type by wealth index showed significant difference between the groups, X^2 (8, N = 5030) = 559.5, p < .001. The number of participants that received prenatal care from an OBGYN, general practitioner or neither differed significantly across education groups [X^2 (6, N = 5030) = 466.9, p < .001]. The majority of the respondents completed primary school, followed by secondary, higher, and no education respectively.

Table 2. *Maternal health characteristics of mothers stratified by type of prenatal care*

II. Maternal health	Total	Neither	GP	OBGYN	P-value
Sample size (n%)	5030 (100)	446 (8.4)	1336 (25.2)	3248 (61.2)	
Age in years at first birth (SD)	19.4 (4.1)	18.6 (4.0)	18.5 (3.5)	19.9 (4.3)	<.001*
Total number of children (SD)	2.5 (1.6)	2.9 (1.8)	2.7 (1.8)	2.4 (1.5)	<.001*

Shown in Table 2 are the maternal descriptive characteristics, mother's age at first birth and total number of children ever born. The mean age for all mothers for age at first birth was 19.4 years (SD=4.1). There was a significant difference in age at first birth and prenatal care type [F (2, 5030) =64.29, p <.001]. Mothers who received prenatal care by an OBGYN (M=19.9, SD =4.3) were older at first birth than those who saw a general practitioner (M=18.5, SD=3.5) and those in the neither group (M=18.6, SD=4.0). The average number of children ever born for all respondents was 2.5 (SD=1.6). There was a significant effect for type of prenatal care and total number of children ever born [F (2, 5030) =34.41 , p<*.001*]. Women in the neither group had the most children ever born (M=2.9, SD=1.8), followed by those who saw a general practitioner (M=2.7, SD= 1.8), and then those who saw an OBGYN (M=2.4, SD= 1.5) for prenatal care.

Table 3. *Nutrient dense food consumption by prenatal care type*

III. Nutrients	Total	Neither	GP	OBGYN	P-value
Vitamin A rich fruit or vegetable (n%)					<.001*
Yes:	727	49 (6.7)	166 (22.8)	512 (70.4)	
No:	4303	397 (9.2)	1170 (27.2)	2736 (63.6)	
Total:	5030	446 (8.9)	1336 (26.6)	3248 (64.6)	
Iodine rich foods (n%)					0.18
Yes:	1182	91 (7.7)	328 (27.7)	763 (64.6)	
No:	3777	352 (9.3)	989 (26.2)	2436 (64.5)	
Total:	4959	443 (8.9)	1317 (26.6)	3199 (64.5)	
Iron rich foods (n%)					<.001*
Yes:	3682	295 (8.0)	930 (25.3)	2457 (66.7)	
No:	1321	151 (11.4)	401 (30.4)	769 (58.2)	
Total:	5003	446 (8.9)	1331 (26.6)	3226 (64.5)	

Table 3 compares micronutrient food consumption across types of prenatal care. As shown, there was a significant difference between groups with respect to reporting consumption of vitamin A fruit or vegetable across prenatal care types [X^2 (2, N = 5030) =13.29, p < .001]. The majority of those surveyed reported not eating iodine rich foods, however no significant difference among groups was detected across prenatal care types. Well over half the population (73.6%) reported eating iron rich foods in the last 24 hours and a significant difference was shown between prenatal care groups [X^2 (2, N = 5003) = 33.18, p < .001].

Logistic regression

Logistic regression analysis was used to determine the association between micronutrient rich food consumption and sources of prenatal care. The dependent variables were vitamin A rich food, iodine rich foods, iron rich foods consumption, consuming any one micronutrient rich food, consuming any two micronutrient rich foods and consuming all three micronutrient rich foods. Having received neither prenatal care type was used as the reference group for these analyses.

Table 4. *Multiple logistic regression analysis of the association between prenatal care type and consumption of vitamin A rich foods*

IV. Vitamin A rich foods	OR	95% CI *Lower*	*Upper*	P-value
Prenatal care received:				
Neither:	*Reference*	------	------	0.08
General Practitioner:	1.14	0.81	1.60	0.45
OBGYN:	1.35	0.98	1.87	0.07
De facto place of residence:				
Countryside:	*Reference*	------	------	0.57
Town:	1.05	0.77	1.44	0.75
Small city:	0.921	0.73	1.16	0.48
Capital, large city:	0.89	0.73	1.09	0.26
Wealth index score:				
Poorest:	*Reference*	------	------	0.03
Poorer:	1.28	1.02	1.62	.04
Middle:	1.26	0.97	1.64	0.09
Richer:	1.27	0.94	1.71	0.11
Richest:	1.74	1.24	2.44	0.001*
Highest education completed:				
None:	*Reference*	------	------	0.79
Primary:	0.83	0.57	1.21	0.32
Secondary:	0.81	0.54	1.22	0.32
Higher:	0.81	0.52	1.26	0.36
Currently married:				
Never:	*Reference*	------	------	0.71
Currently:	1.55	0.95	2.52	0.08
Formerly:	1.63	0.98	2.72	0.06
Smoking status:				
Smoker:	*Reference*	------	------	0.92
Non-smoker:	1.54	0.93	2.54	0.92
Current Age:	1.02	0.99	1.03	0.09
Total children ever born:	0.96	0.89	1.03	0.22

As shown in Table 4, mothers who received prenatal care from General Practitioners had 14% increased odds of Vitamin A rich food intake compared to women receiving care form other sources (Neither), adjustments were made for defacto place of residence, wealth index, highest education level, marriage status, smoking, current age and total children ever born. Also, mothers who received prenatal care from OBGYN had 35% increased odds of Vitamin A rich food intake compared to women receiving care form other sources (Neither), adjusting for other independent variables. A significant difference was detected for Wealth, 74% significantly increased odds of consuming vitamin A rich foods for those mothers scoring in the highest wealth index.

Table 5. *Multiple logistic regression analysis of the association between prenatal care type and consumption of iodine rich foods*

V. Iodine rich foods	OR	95% *Lower*	CI *Upper*	P-value
Prenatal care received:				
Neither:	*Reference*	-----	-----	0.19
General Practitioner:	1.28	0.98	1.66	0.07
OBGYN:	1.20	0.93	1.55	0.16
De facto place of residence:				
Countryside:	*Reference*	-----	-----	0.59
Town:	0.85	0.64	1.12	0.24
Small city:	0.90	0.74	1.09	0.29
Capital, large city:	0.95	0.81	1.12	.55
Wealth index score:				
Poorest:	*Reference*	-----	-----	0.19
Poorer:	0.95	0.79	1.15	0.59
Middle:	1.06	0.85	1.32	0.60
Richer:	0.90	0.70	1.15	0.39
Richest:	1.24	0.93	1.70	0.14
Highest education completed:				
None:	*Reference*	-----	-----	0.75
Primary:	1.13	0.83	1.55	0.44
Secondary:	1.19	0.85	1.67	0.32
Higher:	1.11	0.76	1.63	0.58
Currently married:				
Never:	*Reference*	-----	-----	0.79
Currently:	0.96	0.68	1.37	0.84
Formerly:	1.02	0.70	1.48	0.91
Smoking status:				
Smoker:	*Reference*	-----	-----	0.28
Non-smoker:	0.83	0.59	1.17	0.28
Current Age:	0.99	0.98	1.01	0.65
Total children ever born:	1.00	0.94	1.06	0.97

As shown in Table 5, mothers who received prenatal care from General Practitioners had 28% increased odds of iodine rich food intake compared to women receiving care from other sources (Neither). Also, mothers who received prenatal care from OBGYN had 20% increased odds of iodine rich food intake compared to women receiving care form other sources (Neither), adjusting for other independent variables. Adjustments were made for defacto place of residence, wealth index, highest education level, marriage status, smoking, current age and total children ever born.

Table 6. *Multiple logistic regression analysis between prenatal care type and consumption of iron rich foods*

VI. Iron rich foods	OR	95% *Lower*	CI *Upper*	P-value
Prenatal care received:				
Neither:	*Reference*	-----	-----	0.09
General Practitioner:	1.10	0.87	1.39	0.43
OBGYN:	1.24	0.99	1.55	0.06
De facto place of residence:				
Countryside:	*Reference*	-----	-----	0.69
Town:	0.89	0.68	1.17	0.41
Small city:	0.98	0.81	1.19	0.82
Capital, large city:	0.92	0.78	1.08	0.31
Wealth index score:				
Poorest:	*Reference*	-----	-----	0.00
Poorer:	1.72	1.43	2.06	0.00*
Middle:	1.86	1.50	2.30	0.00*
Richer:	1.85	1.45	2.37	0.00*
Richest:	1.65	1.22	2.22	0.00*
Highest education completed:				
None:	*Reference*	-----	-----	0.08
Primary:	1.38	1.06	1.81	0.02*
Secondary:	1.35	1.00	1.80	0.05*
Higher:	1.51	1.07	2.13	0.02*
Currently married:				
Never:	*Reference*	-----	-----	0.76
Currently:	1.07	0.76	1.52	0.69
Formerly:	1.13	0.78	1.63	0.53
Smoking status:				
Smoker:	*Reference*	-----	-----	0.72
Non-smoker:	1.06	0.76	1.48	0.72
Current Age:	0.95	0.90	1.00	0.07
Total children ever born:	1.01	0.99	1.02	0.39

As shown in Table 6, mothers who received prenatal care from General Practitioners had 10% increased odds of iron rich food intake compared to women receiving care form other sources (Neither), adjustments were made for defacto place of residence, wealth index, highest education level, marriage status, smoking, current age and total children ever born. Also, mothers who received prenatal care from OBGYN had 24% increased odds of iron rich food intake compared to women receiving care form other sources (Neither), adjusting for other independent variables. Additionally, increases in educational attainment and wealth were associated with significantly increased odds of iodine rich food consumption.

Table 7. *Multiple logistic regression analysis of association between prenatal care type and consumption of any one-micronutrient rich food*

VII. Any one micronutrient food	OR	95% *Lower*	CI *Upper*	P-value
Prenatal care received:				
Neither:	*Reference*	-----	-----	0.05*
General Practitioner:	1.09	0.85	1.41	0.49
OBGYN:	1.29	1.01	1.65	0.04*
De facto place of residence:				
Countryside:	*Reference*	-----	-----	0.71
Town:	0.95	0.68	1.32	0.76
Small city:	0.93	0.75	1.16	0.52
Capital, large city:	0.90	0.75	1.08	0.25
Wealth index score:				
Poorest:	*Reference*	-----	-----	0.00*
Poorer:	1.67	1.36	2.05	0.00*
Middle:	2.10	1.63	2.70	0.00*
Richer:	1.77	1.34	2.35	0.00*
Richest:	2.08	1.44	3.00	0.00*
Highest education completed:				
None:	*Reference*	-----	-----	0.03*
Primary:	1.43	1.07	1.90	0.02*
Secondary:	1.56	1.13	2.15	0.01*
Higher:	1.80	1.22	2.65	0.00*
Currently married:				
Never:	*Reference*	-----	-----	0.95
Currently:	1.01	0.67	1.52	0.96
Formerly:	0.98	0.64	1.51	0.93
Smoking status:				
Smoker:	*Reference*	-----	-----	0.59
Non-smoker:	1.10	0.77	1.59	0.59
Current Age:	0.97	0.91	1.03	0.33
Total children ever born:	1.00	0.99	1.02	0.53

A multiple logistic regression analysis was also conducted to evaluate the association of prenatal care type and consumption of any one of three micronutrient rich foods (Table 7). Results indicated that women who received prenatal care from OBGYN were significantly more likely to report eating any one of the three-micronutrient rich foods (OR= 1.29, p=0.04). A significant association was detected for all wealth index scores (p<0.001) with all women outside of the poorest quintile showing increased odds of eating iron rich foods. Additionally, a significant increase in consumption of any one-micronutrient food was detected for all women who completed any level of education and women with the highest education completed showed the largest increase in odds (OR=1.80, *p* =0.03).

Table 8. *Multiple logistic regression analysis of association between prenatal care type and consumption of any two-micronutrient rich foods*

VII. Any two micronutrient foods	OR	95% *Lower*	CI *Upper*	P-value
Prenatal care received:				
Neither:	*Reference*	-----	-----	0.06
General Practitioner:	1.31	1.00	1.70	0.05*
OBGYN:	1.36	1.05	1.75	0.02*
De facto place of residence:				
Countryside:	*Reference*	-----	-----	0.59
Town:	0.89	0.68	1.16	0.38
Small city:	0.92	0.76	1.10	0.36
Capital, large city:	0.90	0.77	1.06	0.21
Wealth index score:				
Poorest:	*Reference*	-----	-----	0.02*
Poorer:	1.25	1.04	1.50	0.02*
Middle:	1.29	1.04	1.59	0.02*
Richer:	1.28	1.01	1.63	0.04*
Richest:	1.59	1.20	2.11	0.00*
Highest education completed:				
None:	*Reference*	-----	-----	0.71
Primary:	1.06	0.78	1.45	0.71
Secondary:	1.00	0.72	1.40	0.99
Higher:	0.93	0.64	1.36	0.72
Currently married:				
Never:	*Reference*	-----	-----	0.10
Currently:	1.31	0.91	1.89	0.15
Formerly:	1.48	1.01	2.17	0.05
Smoking status:				
Smoker:	*Reference*	-----	-----	0.80
Non-smoker:	0.96	0.67	1.36	0.80
Current Age:	0.97	0.91	1.02	0.22
Total children ever born:	1.01	0.99	1.02	0.38

The results of a multiple logistic regression of prenatal care type and consumption of any two-micronutrient rich foods (see Table 8) indicated that both groups of women who saw either type of healthcare practitioner (general practitioner or OBGYN) were more likely to report eating any two of the micronutrient rich foods (*p*=0.05 and *p*=0.02 respectively) than those in the neither group. A significant difference was detected for all wealth index scores (*p*=0.02) for all women outside of the poorest quintile showing increased odds of eating any two of three micronutrient rich foods.

Table 9. *Multiple logistic regression on association of prenatal care type and consumption of all three micronutrient rich foods*

IX. All three micronutrient foods	OR	95% CI *Lower*	*Upper*	P-value
Prenatal care received:				
Neither:	*Reference*	-----	-----	0.39
General Practitioner:	1.48	0.80	2.74	0.21
OBGYN:	1.51	0.84	2.74	0.17
De facto place of residence:				
Countryside:	*Reference*	-----	-----	0.78
Town:	0.72	0.39	1.33	0.30
Small city:	0.95	0.64	1.40	0.78
Capital, large city:	0.95	0.67	1.34	0.78
Wealth index score:				
Poorest:	*Reference*	-----	-----	0.58
Poorer:	1.08	0.73	1.60	0.69
Middle:	0.96	0.60	1.51	0.85
Richer:	0.87	0.51	1.48	0.61
Richest:	1.36	0.76	2.41	0.29
Highest education completed:				
None:	*Reference*	-----	-----	0.73
Primary:	0.72	0.38	1.35	0.31
Secondary:	0.75	0.38	1.47	0.40
Higher:	0.82	0.39	1.74	0.61
Currently married:				
Never:	*Reference*	-----	-----	0.33
Currently:	1.18	0.54	2.57	0.68
Formerly:	1.49	0.66	3.35	0.34
Smoking status:				
Smoker:	*Reference*	-----	-----	0.37
Non-smoker:	1.52	0.61	3.79	0.37
Current Age:	0.92	0.81	1.04	0.19
Total children ever born:	1.01	0.98	1.05	0.55

A multiple logistic regression was conducted to evaluate the association of prenatal care type and consumption of all three micronutrient rich foods (see Table 9). Results indicated that consumption of all three micronutrient rich foods did not differ significantly across prenatal care groups. In addition, no other independent variable was found to be significantly associated with consuming all three micronutrient food groups.

DISCUSSION

The first part of this study aimed to explore current prenatal healthcare utilization, demographics, health behaviors and reproductive history of mothers between the ages of 14 and 49 in the Dominican Republic. The second part of this study aimed to determine association between sources of prenatal care and micronutrient food consumption among mothers using a logistic regression analysis.

The average age of mothers of this sample was 25.6 years old, and the mean age of women at their first birth was 19.4 years. Results also indicated that OBGYNs were utilized for prenatal care more often than general practitioners followed by the neither group. This is in agreement with the numbers from Global Health Initiative, which indicates a wide-ranging healthcare infrastructure and availability of healthcare providers. Significant differences were detected between prenatal care type and the variables highest education level completed, place of residence, wealth index score, and age at first birth.

The result of this study showed no significant association between the type of prenatal care used by mothers and consumption of vitamin A rich foods. A possible driver for micronutrient rich food consumption in women of the Dominican Republic may be wealth (as measured by wealth index). This showed that women who ranked in the richest quintile of wealth index score were 74% more likely to report eating vitamin A rich foods than women with lesser scores. It is possible that vitamin A rich foods may be cost prohibitive for everyone outside of the richest quintile. Another possible reason for this difference may be that those who scored lower on the wealth index scale work in agricultural settings, which emphasizes selling these foods instead of consuming them. The descriptive statistics indicated an overall lack of consumption of these foods with over two-thirds reporting having not eaten a vitamin A rich fruit or vegetable in 24 hours.

No significant factor was found to be associated with consumption of iodine rich foods across prenatal care type. This could be due to the existing low levels of consumption across the sample. No significant prenatal care factor was found to be associated with consumption of iron rich foods. However, all groups with wealth index higher than the poorest quintile were significantly more likely to eat iron rich foods with those in the richest quintile showing a 65% increased odds. Additionally, a significant association between consumption of iron rich foods was observed in women who completed the highest level of education with 51% increased odds. This may also be due to emphasis on agricultural production and not consumption among those who are least educated and poorest. Another possible reason may be related to the prohibitive high cost of meat for those who are the poorest and least educated.

Women who reported using an OBGYN for prenatal care were 29% more likely to report consumption of any one of three micronutrient foods. For the variable "consuming any two micronutrient rich foods", women who reported using a general practitioner (31% increased odds) or an OBGYN (36% increased odds) had increased odds when compared the neither group. This finding supports the hypothesis that women who utilize the services of general practitioners or OBGYN's are more likely to consume micronutrient rich foods than those in the neither group. There was no significant association between consumption of all three micronutrient food types and types of prenatal. But, due to the nature of the survey it is unlikely that someone would report eating all three micronutrient rich foods in one 24-hour period. The results suggest that a nutrition education intervention among prenatal care providers would be most helpful among mothers who do not see general practitioners or OBGYNs.

The driver of micronutrient rich consumption among mothers proved to be wealth and education. Increased wealth index was associated with vitamin A consumption, iron consumption, consumption of any one micronutrient rich food and any two micronutrient rich foods. Education level was associated with increased iron consumption, consumption of any one and consumption of any two micronutrient rich foods.

The analysis of micronutrient rich food consumption across education and wealth index score showed significant results between the groups. A focused intervention providing education on sources of vitamin A rich foods, iodine rich foods and iron rich foods delivered to prenatal care providers who serve the poorest communities would provide the greatest benefit. Overall there is a low consumption of iodine rich foods and no significant differences between the groups suggesting that all three prenatal care provider groups require an intervention for this food type.

This study has several advantages. The data used for this study was obtained from the DHS, which goes through many quality control measures and provides a large sample size for thorough analysis. This is the first study which ventures to examine the differences in micronutrient dense food consumption based on prenatal care type in the Dominican Republic. In addition it provides a descriptive statistics on demographic, behavioral and maternal characteristics of the sample.

The study was limited by using the 24 hour food recall survey to measure micronutrient rich food consumption. The 24-hour food recalls only codes responses as "yes" or "no" and does not take into account quantity consumed. In addition, the 24-hour time span of the survey does not provide a comprehensive view of the dietary patterns of the sample. Previous studies have focused on addressing micronutrient deficiencies of pregnant women and mothers through interventions using supplements, which may not provide a long term or sustainable solution for women in the poor and remote communities.

Further studies of this type should utilize biometric markers for anemia, vitamin A levels and iodine levels in the population to measure micronutrient deficiencies and food consumption patterns more accurately. In addition, there is abundant research linking diet during pregnancy with fetal and infant health, but there is little research linking maternal diet to child diet or micronutrient dense food consumption. So, additional studies should be completed to identify if a mother's diet is significantly different from a child's diet and at what age these may diverge.

Possible interventions for micronutrient rich food consumption would include education programs for prenatal healthcare providers, which target those in agricultural, poor and rural communities. This education should focus on increasing maternal dietary diversity and consumption of vitamin A rich fruits or vegetables and iodine rich seafood products. In order to improve the overall nutrition status of the population, the interventions should also include provision of micronutrient rich foods. Encouraging home gardening or local cooperatives to grow such foods may be necessary in regions where they are not locally available or are too expensive (WHO, 2009). There are currently many programs in the Dominican Republic that provide food supplementation, however, due to the political climate many would not be eligible to receive support. This is because in the Dominican Republic many people who are of Haitian ancestry are denied birth certificates and are stateless which limits their access to government programs, healthcare and education (Jiménez, 2015). In light of this, nutrition education of health care providers and existing community outreach programs, which specifically target the poorest, least educated and agricultural populations could prove to be a part of a sustainable long-term solution to micronutrient deficiency the Dominican Republic.

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