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Causes of Anaemia Among Reproductive Age Women: An Intervention Study in the Eastern Region of India

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Abstract

An attempt is made to understand the correlates of anaemia and examine the response to iron supplementation in some selected villages in West Bengal where anaemia among women is high. Estimates are derived by cyanmethemoglobin method to determine correlates of anaemia. Changes in haemoglobin after oral iron supplementation among women were monitored. Relationships among the variables were analyzed using the SPSS version 14.0 software. Analysis of various micro-level factors demonstrate that women who suffer from severe to moderate anaemia differ considerably in terms of socio-economic, dietary and anthropometric measurements from women who experience moderate to normal levels of anaemia. The lowest haemoglobin level was noticed among the <30 year old women. This is the child bearing and rearing period, making them more prone to anaemia. High rates of live births, heavy workload, poor diet and menstrual disorder are probably responsible for this anaemic condition among women. Uniform improvement in haemoglobin concentration after iron supplementation was not found among women who were at different levels of anaemia before iron supplementation.

Keywords

Anaemia, eastern region, India, cyanmethemoglobin method, intervention, iron supplementation

1. Introduction

Anaemia is a disease that is associated with changes in the blood. It is usually observed as a variable degree of pallor (Kellert 1926). Anaemia is a widespread disorder in the developing world, affecting particularly pregnant women, young children and women of reproductive age (Kanani *et.al.* 1998), which results from one or more of the following processes: defective red cell production, increased red cell destruction or blood loss (WHO 1992). Although iron deficiency is the most common cause of anaemia, especially among younger children and women of child bearing age, other nutrient deficiencies, such as folate and vitamin B12, can also contribute to anaemia (cited in PATH 1996). Anaemia is usually detected by measuring haemoglobin (the iron-carrying part of red blood cells) or by determining the hematocrit (the volume of red blood cells in a specified amount of blood). Anaemia detection is often used as a screening test for iron deficiency.

Half the global total number of anaemic women lives in South Asia (Gillespie 1997). Fifty-five percent of women whose haemoglobin level was tested in National Family Health Survey-3 were found to be anaemic in India. Thirty-nine percent of women were mildly anaemic, 16% were moderately anaemic, and 2% were severely anaemic. The prevalence of anaemia among ever-married women has increased from 52% in NFHS-2 (1998-1999) to 56% in NFHS-3. This reveals that the anaemia situation has worsened over time for women in India (IIPS and Macro International 2007).

Gender biased food allocation and an exaggerated workload are frequent causes of anaemia and malnutrition in girls and women. This bias is culturally acceptable in many societies (Raghavan-Gilbert 1999). The causes of anaemia among South Asian women, as pointed out by UNICEF (2002), Seshadri (1993) and Gillespie (1997), are insufficient quantity of iron-rich foods and "iron enhancers" in the diet (e.g. foods rich in vitamin C such as citrus fruits) and low bioavailability of dietary iron (e.g. foods containing only non-heme iron). An excessive quantity of "iron inhibitors" in a diet, especially during mealtimes (e.g. tea, coffee, calcium-rich foods) may cause anaemia. In addition, anaemia may be due to chronic deficiency of iron or loss of blood or higher requirement of it under certain conditions (poor iron stores from infancy and childhood deficiencies, iron loss during menstruation, iron loss from post-partum haemorrhage, increased iron requirement during pregnancy, repeated pregnancies with less than two years interval and heavy workloads). Poor environmental sanitation, unsafe drinking water and inadequate personal hygiene, and iron loss due to parasite load (e.g. malaria, intestinal worms) are other causes of iron-deficiency anaemia among women.

Anaemia due to iron deficiency is especially associated with several functional impairments. It has a deleterious effect on work capacity and productivity. Anaemia may also predispose pregnant women to higher morbidity, affecting their quality of life and the birth weight of their newborns (Prema et. al. 1981). Anaemia can affect the sense of well-being, lessen resistance to fatigue and aggravate other disorders. According to NFHS-3, except for women in the highest wealth quintile, more than half of women are anaemic in every economic sector. The prevalence of anaemia is high in rural areas and among those who belong to scheduled tribes. Women with 10 or more years of education have also been found to be anaemic. Anaemia has also been found to be lowest among never-married women and highest among women who are widowed, divorced, separated or deserted. The prevalence of anaemia shows a uniform pattern across different age groups. A positive relationship has been detected between total children ever born and anaemia i.e. with increase in number of children, the women are more likely to be anaemic (Frisch 1982). Moreover, women who are currently breastfeeding or who are pregnant are more anaemic than their counterparts (IIPS and Macro International 2007).

The states of Bihar, Orissa and West Bengal have high prevalence of anaemia (Reddy 2004). Moreover, there are area-specific pockets where one can find a high incidence of anaemia. Deficiency is not related to individual health problems but has to do with the availability and adequacy of iron rich foods in regions where a clustering of cases are present (WHO 2000). To

understand the causes of anaemia among women, our study focuses on West Bengal, a state in India where more than sixty percent of the women are suffering from anaemia.

2. Methodology

According to National Family Health Survey (NFHS), Bihar, Jharkhand, Orissa and West Bengal have a high percentage of women suffering from any kind of anaemia. To examine iron deficiency anaemia among women, West Bengal was randomly selected. About 63% of women suffer from anaemia in West Bengal, which is well above the national average, and the prevalence of anaemia has been found to be universal in most of the districts (IIPS and Macro International 2000 and 2007). Five districts which are in the proximity with each other were purposively selected for logistic convenience. The Primary Sampling Units (PSUs) of these five districts of West Bengal using the sample of National Family Health Survey – II were used to examine the anaemia level (IIPS and ORG Macro 2000). From each selected district, a high prevalence village (> 40% women in reproductive ages suffering from any degree of anaemia) and a low prevalence village (≤ 40% women in reproductive ages suffering from any degree of anaemia) were selected. Fifty households were selected by systematic sampling from each selected village. All the women in the reproductive ages (15-49) were interviewed from each selected household. A total of 529 households were covered and a total of 559 ever married women in the age group of 15-49 were interviewed (Unisa et. al. 2010).

2.1 Haemoglobin testing

In each village, on the last day of the survey period, a field level anaemia testing was conducted by two members of a registered pathological lab (a pathologist and an assistant). Haemoglobin testing was carried out by two methods: 1) Helliges blood cell counter method and 2) CYAN-MATH measurement. The best laboratory method for the quantitative determination of haemoglobin is the cyanmethemoglobin method as it serves as a reference for comparison and standardization of other methods (National Committee for Clinical Laboratory Standards 1994). Haemoglobin concentration is determined after a fixed time interval in an accurate, well-calibrated photometer by diluting a fixed quantity of blood with a reagent (Drabkins solution). To determine causes of anaemia, the present analysis used estimates derived from the second method i.e. CYANMATH (Unisa et. al. 2010). A blood test was conducted on a sample of 444 women. Informed consent was taken from each individual before interviews as well as before anaemia testing. The purpose of the study and procedure of interview were clearly explained in the consent forms.

2.2 Analytical procedures

The mean and standard deviation of dependent variable by independent variables were computed. Relationships among the variables were analyzed using the SPSS version 14.0 software. Logistic regression analyzed the relationship among the independent variables and the haemoglobin levels (moderate and severe as 1 and mild and normal as 0) and the predicted values based on logistic analysis are given in the tables. To examine changes in the haemoglobin concentration after iron supplementation, frequency distribution is used. ANOVA and paired comparisons is also used to examine changes after iron supplementation.

3. Results

The respondents comprised of mainly currently married women (96%) living with their husbands. Nearly 45% of the women are illiterate. Most of the head of the households are daily wageworkers (36%). Sixty-three percent of the women are Hindus and 37% are Muslims.

3.1 Levels of anaemia

Three levels of severity of anaemia have been identified: mild anaemia (10.0 – 10.9 g/dl for pregnant women and 10.0 – 11.9 g/dl for non pregnant women), moderate anaemia (7.0 – 9.9 g/dl), and severe anaemia (less than 7.0 g/dl) (CDC 1998). A total of 49% women are moderately anaemic, and 45% are mildly anaemic and less than one percent women are severely anaemic. Overall 49% of the women in the study are suffering from severe or moderate anaemia.

Table 1 presents, observed and predicted percentage of severe and moderately anaemic women by socio-economic characteristics. Variations in anaemia status are discussed on the basis of predicted percentages. Association between anaemia status and age is showing U-shaped pattern. It may be noted from the table that higher percentage of women below 30 years of age are suffering from severe/moderate anaemia. Around 65% women belonging to scheduled caste are suffering from severe/moderate anaemia and this is around 30% higher than the women belonging to general category (See Note 1 for caste and tribe explanation). Hindu women are more severely or moderately anaemic than Muslim women. Further, it can be seen from Table 1 that illiterate women are more prone to be anaemic. There is a negative relationship between standard of living and anaemia.

3.2 Correlates of anaemia

The aforementioned sections confirm that the level of anaemia is high in the study area, thus raising the need to understand the correlates of anaemia. In the subsequent sections, correlates of anaemia are examined by focusing on various factors impacting women: workload, nutritional level, food intake, type of delivery, breastfeeding, and menstruation.

Workload: Heavy physical workload in resource poor setting (high energy expenditure and low energy intake) may also lead to poor nutrition level among women (Untoro et. al. 1998). In the study area, data on daily work such as household chores and outside activities were collected to understand the life style characteristics of women. Questions were asked about the type of work women do in their homes (e.g. about the daily routine she does after she gets up from bed). Routine chores include cleaning utensils, mopping the house, cooking food, washing clothes and making cow dung cakes. Outside tasks include fetching drinking water, collecting fuel or wood, and collecting food for animals. In addition to the abovementioned questions, women in the sample were asked if they rested after each task. A workload index was framed using the above-mentioned households' tasks and resting patterns.

The Table 2 shows a direct relation between levels of anaemia and workload. Higher percentages of women with heavy workload have severe or moderate anaemia. However, it would be interesting to throw some light on the daily schedule of women as observed from the field. In order to obtain a clear understanding of extent of the workload that women have, the following observations were made: "*Women in every village is typically characterized by some household business or agricultural work like making dal vada, paper bag, tokeri, stitching clothes and embroidery work, making cotton sari, and selling guava and milk. They generally get up in the morning by 6 am, take breakfast (mainly puffed rice and tea) and start their daily household work. After taking lunch at around 2 o'clock, they take rest for an hour. Majority of them are involved in household business till their husband returns home in the evening*". The field note above suggests that women in all of the surveyed villages are busy taking care of household work as well as business throughout the day and this has adverse impact on their health.

Nutrition level and food intake: Body Mass Index (BMI)—detecting the risk of health or nutritional disorders as defined by the weight in kilograms divided by the height in meters squared—is used as a proxy measure of nutrition level among women. BMI is also used to assess both thinness and obesity. Chronic Energy Deficiency (CED) (malnourished) refers to a BMI of less than 18.5 i.e. intake of energy less than the requirement for a period of several months or years. Women with a BMI of 25.0-29.9 are considered to be overweight and those with a BMI of 30.0 or above are identified as obese (WHO Expert Consultant 2004). Three categories of BMI have been formed for the present study,

namely, malnourished, normal and overweight/obese. It can be seen from Table 3 that around 50% women who are malnourished or normal are suffering from severe/moderate anaemia.

The other correlates of anaemia that requires attention is food intake. Information with a 24-hour recall was collected from the study sample to investigate nutrient content. Table 3 reveals that green leafy vegetables are taken daily or weekly by most of the women and the variation by levels of anaemia are not distinct. Women who consume fruits seasonally are less prone to be anaemic in comparison to those women who never consume fruits (48 vs 54%). Among women who often consume Vitamin C have lower degree of anaemia as compared to those who sometimes/rarely consume Vitamin C. Among women who rarely consume *dal* (pulses), around 70% of them are suffering from severe/moderate anaemia. Consumption of non-vegetarian food and milk/milk products are not showing any noticeable differences. This requires further analysis on quantity consumed and level of anaemia to draw any inference.

To get a clear idea whether the food they eat is nutritious or not, several observations in the field were made. One such field observation is given below: "*For preparation of vegetables, (green leafy or any other) vegetables are first cut into small pieces and kept in a water filled bowl. Mostly wood, coal, dry leaves and cow dung are used as fuel. Vegetables are cooked under high flame. They first soak the vegetables in the water. Just before cooking, the water is thrown away and then the vegetables are fried in little oil and then boiled in high flame. Often the lid of the cooking utensil is kept half open while boiling the vegetables. Most of the time they cook mixed vegetables. While cooking fish, they fry it in less oil but under high flame and generally mix it up with vegetables. After cooking all the items, they keep the cooked food open for an hour. Until the food is cooked, they keep aside the lid of the bucket from where they use the water".*

The quote above reveals that the mode of cooking is unhealthy. Most of the nutritional value from food gets discarded due to keeping vegetables in water after cutting or cooking with high flame. It could be possible that the method of cooking is one of the factors that have led to high levels of anaemia in the study area.

Reproductive health: In order to determine causes of anaemia by reproductive health of women, type of delivery (whether normal or Caeserian), number of living children, whether the women is currently breastfeeding and menstruation problems are considered (Table 4). Higher percentage of women who had Ceasarian delivery are severely or moderately anaemic than women who had normal delivery. Among women who are currently breastfeeding, they have 10% higher chance of being severely or moderately anaemic than those who are not currently breastfeeding.

Menstrual blood loss is difficult to measure and establish association with anaemia. Hence, menstrual characteristics have been collected from women for three consecutive menstrual cycles. Women who have irregular menstruation are more prone to be anaemic than women who have regular menstruation. Women who feel tired or have lower abdominal pain are severely anaemic compared to their counterparts (Table 5).

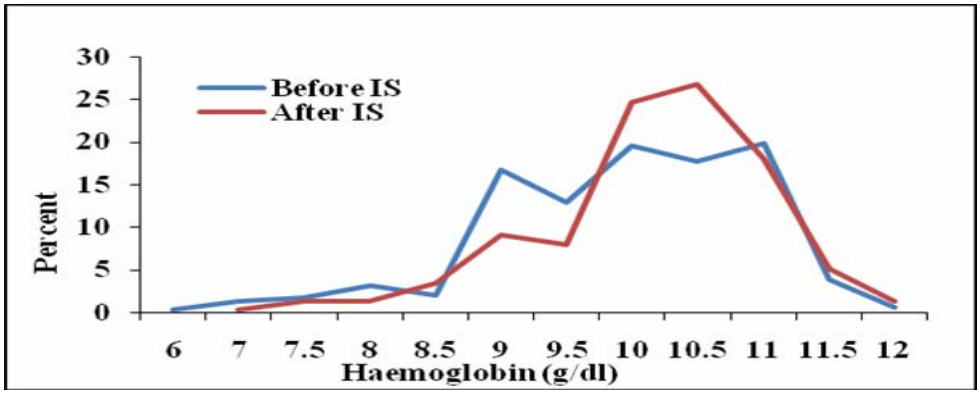
3.3. Intervention and response to iron supplementation

In addition to measurement of haemoglobin, assessment of iron deficiency anaemia is possible only by multiple tests. Further, iron related tests do not correlate closely with one another and also involve high cost (Dallman et. al. 1981; Expert Scientific Working Group 1993; Hallberg et. al. 1993; Path 1996; WHO 2001). One established approach to the diagnosis of iron deficiency in population, particularly in large-scale surveys and resource poor countries, involves monitoring the changes in haemoglobin level after oral supplementation (Stoltzfus 2001; Yip 1994). In the present study also, iron supplement method is used to examine iron deficiency in the sample women. A follow-up of 352 women whose haemoglobin level was less than 12g/dl in the baseline survey was carried out after one month of giving them iron tablets. Finally, 287 women participated in the second round for

monitoring changes of haemoglobin concentration as some women either had gone to visit their relatives due to summer holidays or they refused to give blood test and four women did not take tablets.

Iron supplementation remains an important strategy for the prevention and treatment of iron deficiency anaemia and can produce substantial improvements in the functional performance of iron deficient individuals and populations (Allen 2002). An increase of at least 1g/dl in haemoglobin after one or two months of supplementation is indicative of iron deficiency (Suharno et. al. 1993; WHO 2001). In the study area, iron supplementation led to an improvement in the haemoglobin concentration among women (Figure 1). Around two thirds of women showed improvement in haemoglobin level.

Figure 1: Haemoglobin concentration before and after iron supplementation



IS= Iron Supplementation

Mean improvement in haemoglobin concentration by the level of anaemia is studied with the help of Analysis of Variance (ANOVA). Severely anaemic women showed a 3g/dl improvement (although the number of women are less in this category) followed by moderate and mild anaemic women. A paired comparison of mean level of haemoglobin (pre and post iron supplementation) reveals that improvement is not uniform among women. This finding may be because preventive/corrective iron supplementation of 60 mg/day iron with 400 µg folic acid for three months is advisable in areas where prevalence of anaemia among women of childbearing age is severe (>40%). However, in the present study, iron supplementation was given only for one month.

Women above 35 years of age and those currently married exhibited improvement in haemoglobin after iron supplementation. In addition, scheduled caste (or scheduled tribe women) and women belonging to high standard of living showed improvement in level of haemoglobin. Women from lower weight and shorter height categories did not show any improvement in haemoglobin concentration (Unisa et. al. 2010). The findings, therefore, illustrate chronic nutritional deficiency among women. There remains, however, the possibility that these women have suffered from other forms of anaemia or diseases (e.g. in the study area, two women reported that they suffer from thalassaemia).

4. Conclusions

Anaemia is the most common disorder in many developing countries. Ninety percent of adolescent girls, women and children in India suffer from anaemia (Agarwal et. al. 2005). There are several kinds of anaemia that result from a variety of causes, but the most common and severe type of anaemia is iron deficiency anaemia (Indian Council of Medical Research 1997). Hence, an attempt has been

made in this paper to understand the correlates of anaemia and examine the response to iron supplementation in West Bengal, where anaemia level is well above the national average.

Analysis of various micro-level factors demonstrated that consistent differences exist in socio-economic, dietary and anthropometric measurements between women who suffer from severe/moderate anaemia and women who experience mild and normal levels of anaemia The lowest haemoglobin level was noticed among the <30 year old women. This is the child bearing and rearing period making them more prone to anaemia. High rates of live births, heavy workload, poor diet and menstrual disorder are probably responsible for this anaemic condition among women. In addition to this, if the woman has a heavy workload and does not rest, the severity of anaemia increases. One of the predicted causes of anaemia, apart from workload, is consumption of food. Consumption of fruits, vitamin C and *dal (pulses)* are quite low among anaemic women. Relatively, a large number of them are unaware about the correct food items to be consumed to prevent anaemia. This finding supports a study by Swaminathan (1985) who opined that the diet consumed by a large majority of the population consist predominantly of cereals and contain small amount of legumes and vegetables and negligible amount of milk, egg, meat and fish.

Uniform improvement in haemoglobin concentration after iron supplementation for one month was not found among women who are at different levels of anaemia before iron supplementation. Women with low weight and short height (which is indicative of a form of chronic nutrition deficiency) do not show improvement in haemoglobin concentration.

Based on the study and the experience gained during the field survey, it is recommended that women of childbearing age be tested for iron-deficiency anaemia, especially if they have a history of iron-deficiency anaemia, heavy blood loss during their monthly periods, or other risk factors for iron-deficiency anaemia. The women need to be educated on what a balanced and healthy diet is and how to attain it via iron-rich foods that include eggs, whole grains, beans, meat and vegetables. Hence, a community-based intervention is required to educate women about their health.

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Note 1:

Status of a person in India is determined by birth according to social groups based on the caste system. Ranking of the caste is based on four-fold Varuna grouping with Brahmins at the top followed by Warriors (marital community), Vaishyas (trading community) and Shudras (the untouchable) at the bottom (Bhagat, 2006). The Scheduled Tribes are called Adivasi, meaning aboriginals.

The Indian Constitution declared certain castes and tribes as scheduled castes (SC) and scheduled tribes (STs) to create a system of affirmative action in employment and education for these groups. Other backward classes (OBCs) are a group of castes that are also supposed to be backward in respect of socio-economic development, but their social position is better than STs and SCs.

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Table 1: Anaemia status of women by background characteristics

Background characteristics	Observed percentage of severe/moderate anaemia*	Predicted percentage of severe/moderate anaemia**	Total women
Age Of Women			
15-19	59.3	78	27
20-24	50.7	53	75
25-29	52.7	52	74
30-34	31.0	33	71
35-39	52.0	54	75
40-44	54.3	49	70
45-49	47.6	54	42
Current Marital Status			
Currently Married	48.3	49	418
Separated/Divorced	(66.7)	(100)	18
Caste			
Scheduled Caste/Scheduled Tribe	65.7	65	137
Other Backward Caste	51.6	48	62
General	38.2	36	170
Religion			
Hindu	51.9	51	297
Muslim	44.9	45	147
Women's Educational Attainment			
Illiterate	57.2	52	201
Literate	42.9	47	242
Husband's Educational Level			
Illiterate	57.1	54	126
Literate	45.5	47	301
Standard of Living			
Low	53.6	57	125
Medium	48.5	47	239
High	46.3	46	80
Total	**49.6**	**49**	**444**

Note: () Based on <25 cases

* Haemoglobin level cut off for moderate/severe anaemia is below 10gm/dl

** Predicted percentage are based on logistic analysis controlling for all other variables

Table 2: Anaemia status of women by workload

Workload	Observed percentage of severe/moderate anaemia*	Predicted percentage of severe/moderate anaemia**	Total women
Low	50.4	44	135
Medium	48.3	51	271
Heavy	57.6	63	33

*Haemoglobin level cut off for moderate/severe anaemia is below 10gm/dl

** Predicted percentage are based on logistic analysis controlling for all other variables

Table 3: Anaemia status of women by nutrition level and food intake

Correlates	Observed percentage of severe/moderate anaemia*	Predicted percentage of severe/moderate anaemia**	Total women
Nutrition level			
Malnourished	53.6	50	156
Normal	49.4	51	241
Overweight/Obese	30.6	34	36
Food intake			
Green Leafy Vegetables			
Often	50.0	50	424
Rarely	(36.8)	(47)	19
Fruits			
Seasonally	48.5	48	299
Sometimes	50.0	53	112
Never	56.3	54	32
Vitamin C			
Often	42.0	45	50
Sometimes	50.7	49	217
Rarely	49.4	52	174
Non-Vegetarian			
Often	48.3	50	207
Sometimes	50.7	50	213
Rarely	(47.8)	(38)	23
Dal (Pulse)			
Often	48.6	48	387
Sometimes	(45.0)	(62)	20
Rarely	61.1	71	36
Milk and Milk Products			
Often	49.7	50	175
Sometimes	45.9	42	74
Rarely	50.5	52	194

Note: () Based on <25 cases

*Haemoglobin level cut off for moderate/severe anaemia is below 10gm/dl

** Predicted percentage are based on logistic analysis controlling for all other variables

Table 4: Anaemia status of women by type of delivery[#] and breastfeeding

Type of delivery and breastfeeding	Observed percentage of severe/moderate anaemia*	Predicted percentage of severe/moderate anaemia**	Total women
Last delivery			
Normal	49.4	49	258
Caesarian section	(52.2)	(53)	25
Living children			
1-3 births	47.7	49	257
3+ births	55.1	49	26
Currently breastfeeding			
No	46.2	47	208
Yes	56.1	57	75

Note: () Based on <25 cases; [#] Based on those women who have at least one child
*Haemoglobin level cut off for moderate/severe anaemia is below 10gm/dl
** Predicted percentage are based on logistic analysis controlling for all other variables

Table 5: Anaemia status of women by menstrual characteristics

Menstruation characteristics	Observed percentage of severe/moderate anaemia*	Predicted percentage of severe/moderate anaemia**	Total women
Regular menstruation			
No	54.1	55	61
Yes	48.7	49	378
No. of days of menstruation per cycle			
1-4	47.5	49	284
5 and above	51.1	50	92
No. of clothes/napkins used per cycle			
1-9	47.5	50	240
10 and above	50.4	47	127
Feel tired during menstruation			
Always	56.9	60	58
Most of the time	53.7	50	67
Rarely	44.4	47	45
Never	45.4	48	205
Lower abdominal pain during menstruation			
Always	57.1	61	49
Most of the time	56.7	53	67
Rarely	42.6	48	68
Never	45.6	47	191
Whether get blood clots at the time of menstruation			
No	47.9	50	286
Yes	50.6	47	85

*Haemoglobin level cut off for moderate/severe anaemia is below 10gm/dl
** Predicted percentage are based on logistic analysis controlling for all other variables