Academia Journal of Biotechnology 4(11): 422-429, November 2016
DOI: 10.15413/ajb.2016.0285
ISSN 2315-7747

Research Paper

A case-study of the Lifestyles Characteristics and the Risk of Anaemic among Menin Peri-urban Community in Accra, Ghana

Accepted 6th June, 2016

ABSTRACT

Anaemia is a reduction in circulating red blood cells which directly affect the concentrations of haemoglobin. This affects cognitive development and cause fatigue and low productivity. Apart from overt or covert haemorrhage, intestinal and urinary infestation of worms and blood infection of microbes, anaemia is mostly caused by deficiency of dietary nutrients such as iron, Folic acid, vitamin B_{12}, sometimes vitamin C, copper or dietary protein. The most common of all is dietary iron deficiency anaemia. In addition, many factors such as socio-economic status, and lifestyles contribute to anaemia. Iron deficiency, is still a problem that persists in the world especially in many underdeveloped countries. A cross-sectional study in a peri urban community in Ghana enrolled one thousand four hundred and forty-nine (1,449) healthy men aged ≥18 years. The study assessed their lifestyle variables, dietary intake and nutrient adequacy ratio (NAR), body mass index (BMI), clinical assessment and their blood haemoglobin (Hb) levels. Determinants of risk of developing anaemia was estimated using binary logistic regression analysis. An alpha level of 5% were considered significant. Biochemical and clinical examinations revealed that 18.8% of the participants were anaemic (Hb ≤13b/dL). The anaemia prevalence found in this study was higher than global prevalence for men. Dietary status of the participants were below the cut-off of 60% NARfor all nutrients assessed except for iron (84%) and protein (55%) that fell below 40% NAR. Participants' diet were largely plant based which was another possibility of not making the iron bio-available. The output of the binary logistic regression indicated that participants who used tobacco were about 16 (Odds ratio: 16.39, p<0.01) times more likely to be anaemic as compared with non-users. In the same model, men whose intake of protein was (<60% NAR) were 3 (Odds ratio: 3.44, p<0.01) times more likely to be anaemic. Iron is needed for haemoglobin while protein is needed for protoporphyrin and globin for haemoglobin synthesis. Tobacco smoking and low intake of protein were high risk factors for the incidence of anaemia among men in a peri urban community in Ghana.

Key words: Anaemia, nicotine, haemoglobin, protoporphyrin.

Abbreviations: BMI: Body Mass Index; **ENT:** Ear Nose and Throat infections; **GDHS:** Ghana Demographic and Health Survey; **Hb:** Haemoglobin; **MAR:** Mean of all the ratio; **MDG:** The millennium development goals; **NAR:** Nutrient Adequacy Ratio; **RDA:** Recommended Dietary Allowance of all nutrients; **SBP:** Systolic Blood Pressure, **SES:** Socio-economic status; **SHS:** Senior High secondary School, **URI:** Urinary Tract Infection; **UTI:** Upper Respiratory Infections; **SD:** Standard Deviation.

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INTRODUCTION

Men do not usually suffer from anaemia as much as other physiological groups such as children and women in their reproductive ages. This is because of the physiological and anatomical make-up of men.However, anytime and anywhere that significant number of men are anaemic should mean an urgent need for nutrition and health interventions. The literature revealed that men's nutrition and health studies are not major concerns for most researchers. Nevertheless, men are known to have higher mortality rates and shorter life span (Lynch, 2013; Wang et al., 2013; White and Holmes, 2006; White et al., 2013; Wang et al., 2010).

In Ghana, life expectancy at birth is 63.38 years for men and 66.19 years for women (Ghana Demographic and Health Survey 2008, 2009).

Therefore, it is essential to know the critical nutrition and health matters concerning men. This study gives a concise finding to explain some of the discrepancy in men's health status. It is anticipated that the results would serve as few steps toward ascertaining and dealing with the gaps in men's health.

Globally, 'the millennium development goals (MDGs) and post-2015 global development agenda were basically set for women and children (Millennium development goals, 2015; Awortwi, 2012; Hippisley-Cox et al., 2007; The Millennium Development Goals Report, 2008). Out of the eight MDGs goals, none was set to address any issue concerning men. Nationally, 'the Ghana Demographic and Health Survey' (GDHS) report conducted every five years does not take men's nutrition and health so seriously. For instance, GDHS report of 2003 on nutrition recognized relevant data on breastfeeding, complementary feeding, and micronutrients intake with respect to children and women only. In GDHS (2008) report similar survey report was presented, however,"regenerative nutrition project" documented few concerns about men's lifestyles such as their vigorous physical activity, duration of rest, consumption of water, fruits and vegetables intake (Ghana Demographic and Health Survey 2008, 2009, 2004, 2003).

It was also noted that relatively little attention has been placed on peri-urban communities in terms of nutrition and health research. There is an obvious knowledge gap that needs to be filled in these communities. It has also been predicted that members of peri-urban communities could be socio-economically and nutritionally poorer than either urban or rural areas (Maxwell et al., 2000). So, peri-urban zones were considered for this study.

Balanced and adequate food containing all the essential nutrients in their right proportions are needed for healthy life. However, if the balanced food is not taken in the right quantity and at the right time, it could overturn the importance of the balanced diet.

Studies have shown that excessive alcohol consumption is responsible for the deaths between 88,000 and 2.5 million of potential life lost in the United States each year (McKnight-Eily et al., 2014). It is documented that chronic ingestion of ethanol ($C_2H_2O_5$) alters the hematopoietic system resulting in folate deficiency (Maruyama et al., 2001). Although, the mechanisms by which alcohol causes anemia have been well described, recent studies indicate that alcoholics tend to have iron stores that are greater than normal (Kohgo et al., 2008; Moirand et al., 1997).

Moirand et al. (1997) found that iron stores increase progressively across classes of alcohol intake in alcoholics and heavy drinkers. Teetotalers who were compared to volunteers drinking small amounts of alcohol showed significant increase in indices of iron stores, such as ferritin (Whitfield et al., 2001).

Similarly, a significant correlation was observed between ethanol concentration and haemoglobin concentration among women (Milman and Pedersen, 2009). Since most alcoholic beverages such as beer and wine are sources of many hematopoietic nutrients such as iron, folate, riboflavin, pantothenic acid, pyridoxine and niacin, it is reasonable for a positive association to exist between ethanol concentration and blood haemoglobin concentration (Klobodu et al., 2014). A meta-analysis of prospective observational studies revealed that types of alcoholic beverages that alcohol drinkers consume makes little difference, however, the pattern of consumption does. It was found that frequency of consumption (such as daily) yield maximum health benefits (Koppes et al., 2005). A large study in 2008 found that moderate drinkers (after adjusting for several factors) preserve their high longevity benefit over alcohol abstainer (Lee et al., 2009).

In almost all populations studies, men smoke more than women and that, among smokers, men have more dangerous smoking habits than women (Lundberg et al., 2007; Stafford and McCarthy, 2006). Tobacco has chemicals that are deleterious to both partial and actual smokers. Studies have revealed that inhaling, irrespective of how little tobacco smoke may be, can be harmful (Health and Services, 2010, 2004, 2006). Tobacco smoke contains more than 7,000 chemicals and at least 250 are known to be detrimental, such as carbon monoxide, hydrogen cyanide and ammonia (Health and Services, 2010, 2006). Nicotine is one of those chemical compounds in tobacco that is biologically accountable for addictive property of tobacco products to consumers (Hatsukami et al., 2008).

Many societies view tobacco smoking as a desired masculine norm. Globally, 48% of adult men smoke as compared to 12% of women (Health and Services, 2010). Smoking prevalence among the adults in Greater Accra (both urban and rural) stood at 10.8% males and 4% females (Al-Bedah et al., 2010; Amoah et al., 2002). In Ghana, smoking is banned in many areas such as restaurants, bars, in government buildings (including work sites), private work sites, educational facilities and health care facilities. It is also banned to sell any tobacco products to minors. It is restricted in advertisements in media and public locations. It is however, not regulated in its accessibility and availability but there are free products on the market (Blons et al., 2006; Ferlay et al., 2001).

Anaemia is a reduction in circulating red blood cells which directly affect the concentrations of haemoglobin. This adversely affects cognitive development, motor development, cause fatigue and low productivity (Balarajan et al., 2011; Stoltzfus et al., 2004; Haas and Brownlie, 2001).

Apart from overt or covert haemorrhage, intestinal and urinary infestation of worms and blood infection of microbes, anaemia is mostly caused by deficiency of dietary nutrients such as iron, folic acid, vitamin B_{12} and sometimes vitamin C, copper or protein deficiencies. The most common type of anaemia is iron deficiency anaemia (Nishida et al., 2004). Factors such as unhealthy lifestyles also contribute to incidence of anaemia (Killip and Bennett, 2007). Iron deficiency anaemia persists in both developed and underdeveloped countries (Miranda et al., 2003). In iron deficiency, Hb concentrations fall and hypochromic and microcytic anaemia ensured; this affects over 1 million people worldwide (de Benoist et al., 2008).

Anaemia can be defined as a condition in which the haemoglobin (Hb) levels are lower than normal (<14g/dL) for men. The adult human body contains 3 to 4 g of iron and approximately 70% of which is present in Hb in red blood cells and myoglobin in muscle.

Iron is instrumental for the transport of oxygen around the body and is an essential component of many enzymes and cytochromes where it plays a role in electron transport systems, respiration and hormone synthesis. As a result of these multiple functions, iron is important for physical performance, immunity, cognitive development and functions such as, thermo-regulation, and thyroid metabolism.

The body efficiently recycles iron from degraded red blood cells, so that daily requirement to replace endogenous losses from the gastrointestinal tract, skin, hair, and sweat is relatively low, at about 1to 15 mg/day (Fairweather-Tait et al., 2014).

Good food sources of iron include meat and meat products containing haemoglobin iron; oily fish such as tuna and sardines; cereal products such as fortified breakfast cereals, eggs, pulses, and dark green vegetables (Fairweather-Tait et al., 2014).

The relationship between iron intake and iron status is complicated by variations in the efficiency of iron absorption, but a systematic review of randomized clinical trials showed a positive time-dependent association between iron intake from supplemental iron and serum ferritin (Casgrain et al., 2012).

A study documented modifiers of iron bio-availability and positive association with serum ferritin were observed for haemoglobin iron, supplemental iron, vitamin C and alcohol (Fleming et al., 1998).

Another study involving Danish men and women evaluating iron status and its relationship with diet and supplement use, reported a direct correlation between serum ferritin and intakes of dietary iron ($p=0.03$), meat ($p=0.013$), alcohol ($p<0.001$), and BMI (in men only, $p=0.025$), and a negative correlation with tea consumption ($p=0.017$), but no association between supplement use and iron status (Milman et al., 2004).

Although, individual dietary enhancers and inhibitors identified from single meal absorption studies may have a significant impact on iron absorption and hence, its status (Hurrell and Egli, 2010). Collings et al. (2013) reported that, it is more important to use data on iron absorption from whole diets to predict iron status.

MATERIALS AND METHODS

Study design and setting

A cross-sectional, community-based, study involving adult men ≥ 18 years of age was carried out. The study was conducted in a peri-urban community near Accra, the capital of Ghana. The community was selected using two-stage sampling approach. The first stage involved a simple random selection of a political district out of eight districts in the Greater Accra Region (one of the ten political regions of Ghana). The second stage was also a simple random selection of one of the twelve peri-urban communities from the District selected. A house-to-house visits were conducted to explain the details of the study and to enlist all the 7161 eligible men living in the community out of which one thousand four hundred and forty-nine (1449) men willingly participated in the study.

Ethics

The study was conducted according to the guidelines laid down. All procedures involving the subjects were approved by the Noguchi Memorial Institute for Medical Researchbased on 'no more than minimal risk' to the participants, the voluntary participation and the maintenance of the rights; privacy and confidentiality of the participants were ensured with the approval code: #036/14-15.

Data collection and measurements

Before the data collection, all research instruments were pretested in a different but similar community in the same district. Detectable flaws in the research instruments were resolved after pretesting. The WHO stepwise questionnaires were modifiedand translated into local languages in the study area. Information on demographic, socio-economic, lifestyle behaviours, dietary, anthropometry and clinical data were collected. Biochemical tests were carried out to measure the haemoglobin of the subjects. (Manufactured by HemoCue AB, SE-262 233 Angelholm, Sweden and distributed by HemoCue Inc. 40 Empire Drive, Lake Forest, CA 92630 USA). The acceptable cut-off level of haemoglobin for an adult man is >13g/dL and deficiency is ≤13g/dL. Therefore, the expected values for men ranges >13.0 g/L (Mitchell et al., 2001; Nkrumah et al., 2011).

Nutrient adequacy and mean adequacy

To estimate the value of nutrient intake, NAR was calculated for 9 nutrients.The NAR is the actual nutrient intake divided by the RDA (Kvaavik et al., 2004) and expressed as a percent. RDAs are often used to compare dietary quality among population subgroups (Ries and Daehler, 1986; Torheim et al., 2004; Madden et al., 1976; Guthrie and Scheer, 1981). RDAs represent the amounts of nutrients that are adequate to meet the needs of most healthy people (about 97%). The NAR was based on the percentage of the RDA for each nutrient from all the "n" different foods intake and calculated as:

$$NAR_i = 100/n * \sum_{p=1}^{p=n} \left(\text{Intake}_p / \text{RDA}_p \right)$$

Where Intake p is the daily intake of each nutrient p, (from the mean of all food taken per day) and RDAfor a day and "n" is the list and reference value for the "n" recommended nutrients, but in this case "n" is one nutrient. Thus, allowance for that nutrient. NAR*i* is the actual total amount of a nutrient intake per day, calculated for the whole diet but excluding alcoholic beverages, tea, coffee and drinking water.

The NAR for a given nutrient is the ratio of a subject's nutrient intake to the current RDA (Hatluy et al., 1998). Except for calories, RDAs are set at levels that exceed the requirements of the vast majority of healthy people for most subjects. The allowance state very clearly that intakes below the RDA for a nutrient are not certainly inadequate. This means failure to consume the recommended amounts cannot necessarily be interpreted as a dietary deficiency. This warning against misinterpretation is particularly critical with analysis of one-day intake.

There are several approaches for determination of adequacy of diets. The most widely used method is the cut-off method, which estimates the intake of nutrient below a given value of the RDAs. Many different cut-off points have been used such as 80, 66 and 50% respectively. This study used 60% cut-off point as presented.

A value of 77% of the RDA is a value that represents the mean requirement for a given age group. If the RDAs are considered to represent the mean requirement +2 Standard Deviation (SD) and the SD is 15% of the mean in most biological measure, then, RDA equals 130% of the mean. The mean requirement is represented by 77% of the RDA (100/130). The requirement of half the population is below 77% of the RDAs. It is not appropriate to consider that levels falling below the RDAs or any value of RDA indicate dietary deficiencies, although, it is appropriate to consider levels well below the RDAs to indicate risks to dietary adequacy. The existence of deficiencies must be confirmed or rejected on the basis of anthropometric, clinical or

Since the adequacy of the diet is a function of the extent to which contribution of particular nutrients meets our best estimate of the need for nutrients, it is helpful to calculate a NAR for nutrient. When NAR is greater than 1, the requirement is met. If it falls below 1 it may still be sufficient, since the RDA is set at the mean requirement of 77% RDAs. The farther the NAR falls below 77%, the higher the probability that the diet will fail to meet the needs of the individual.

As an overall measure of the nutrient adequacy, the MAR was calculated as described by Madden et al. (1976):

$$MAR = \frac{\sum \; NAR(each\ truncated\ at\ 1)}{Number\ of\ nutriets}$$

The NAR for calories, protein, fat, carbohydrates, iron, calcium, sodium, vitamin B_1 and vitamin B_{12} consumed were used to arrive at MAR. NAR was truncated at 1 so that a nutrient with a high NAR could not compensate for a nutrient with a low NAR.

Definitions of variables in the binary regression model

Dependent variables: Haemoglobin (Hb):> 13g/dL= normal for men; ≤13g/dL=anaemia for men.

Independent variables: Age (in completed years): >40 years; ≤40 years.

Alcohol: Yes or no.

Tobacco use: Yes or no.

Dietary protein: ≥60%; NAR=normal; <60%NAR= deficiency.

Dietary iron: ≥60% NAR=normal; <60%NAR= deficiency.

Data analysis

The food data were broken down into nutrients using ESHA Food Processor (ESHA Research, 2012w, 4747 Skyline Rd s, Suite 100, Salem. OR 97306 USA), MS Excel 2013 (Microsoft Corp, Redmond, WA) soft wares and assisted by Ghanaian Food Composition Table (Eyeson and Ankrah, 1975) to analyze the dietary data. Various nutrients consumed per person per day were calculated and compared with the recommended dietary allowance (RDA) (Kvaavik et al., 2004) from which NAR and Mean nutrient Adequacy Ratio (MAR) were determined. The Food Processor takes into account the age, BMI, type of usual work as well as, the exercise the participants does in determining the subject's RDA before generating the NAR for each individual. Data entry and management system were done using SPSS version 16 (SPSS Inc, Chicago, IL). Descriptive statistics (frequencies, mean, median, standard deviations, and ranges) were calculated for continuous variables and proportions for qualitative variables. Means of continuous

Table 1. Background characteristics of Men Participants (N=1449).

Variable	[1]Age (Years; n (%))					
Age (Years)	**18-30**	**31-40**	**41-50**	**51-60**	**>60**	**Total n(%)**
Education	-	-	-	-	-	-
<SHS	203 (54.7)	294(68.9)	252 (80)	147(70)	63 (50)	959(66.2)
≥SHS	168 (45.3)	133(31.1)	63 (20.0)	63(30)	63 (50)	490 (33.8)
Alcohol use						
Users	182(49.1)	322 (75.4)	252 (80)	189 (90)	84 (66.7)	1029(71.0)
Tobacco user	-	-	-	-	-	-
Users	21 (5.7)	70 (16.4)	42 (13.3)	126 (60)	63 (50)	322 (22.2)
Physical activity score						
Inactive	42 (11.3)	84 (19.7)	126 (40)	42 (20)	21 (16.7)	315 (31.9)
Moderate	245 (66)	259 (60.7)	147 (46.7)	147 (70)	105 (83.3)	903 (66.7)
Active	84 (22.6)	84 (19.7)	42 (13.3)	21 (10)	0	231 (1.4)
Nutrient Adequacy Ratio ([2]NAR) by age distribution						
NAR ≥60%	-	-	-	-	-	-
Calories	63 (17)	63 (14.8)	42(13.3)	42(20)	63(50)	273 (24.3)
Protein	203 (54.7)	252 (59)	147 (46.7)	126 (60)	63(50)	791(54.6)
Fat	84(22.6)	105 (24.6)	84 (26.7)	63 (30)	63 (50)	399(27.5)
Carbohydrate	84(22.6)	84 (19.7)	63(20)	63(30)	63(50)	357(24.6)
Dietary iron	350(94.3)	364(85.2)	231(73.3)	168 (80)	105(83.3)	1218 (84.1)
Dietary calcium	203(54.7)	168 (39.3)	210(66.7)	84(40)	42(33.3)	707(48.8)
Dietary sodium	63 (17)	105 (24.6)	63 (20)	84 (40)	84(66.7)	399(27.5)
Vitamin B_1	63(17)	126(29.5)	63 (20)	42 (20)	21 (16.7)	315 (21.7)
Vitamin B_{12}	21 (5.7)	63 (14.8)	21 (6.6)	84 (40)	21 (16.7)	210(14.5)
[3]MAR ≥60%	168(45.3)	147 (34.4)	147 (46.7)	105(50)	63 (50)	630(43.5)

[1]Age in completed years; [2]NAR= X/RDA x 100. Where X= weight of dietary nutrient and RDA= Recommended Dietary Allowance of all nutrients; [3]MAR=Mean of all the 9 NARs each truncated at 1, SHS= Senior High secondary School

variable were compared between various levels of other variables using ANOVA. Proportions of categorical variable were also compared using Chi-square test. To assess the association between outcome variables and independent variables, binary logistic regression analysis was carried out. The significance was set at an alpha level of 5%.

RESULTS

The study participants were made up of one thousand four hundred and forty-nine (1,449) men with a mean age of 40±14.3, ranging from 19 to 95 years. About a third (33.8%) of the participants had completed Senior High Secondary (SHS) education and above. More than three-quarter (71.0%) of theparticipating men in the community were alcohol users. An appreciable number (22.2%) of them also used tobacco. Older subjects had the higher rate of tobacco smoking than the younger groups.The participants were largely physically active (98.6%). Lesser number (<40%) of the participants met the cut-off of >60% NAR for all the nutrients intakes except iron (84.1%) and protein (54.6%) and only 43.5% of the study population met ≥60% of the overall nutrients need (Table 1).

About three fourth of the men were within the normal BMI ranges of (18.24 to 24.9 kg/m^2) (68.1%). However, about 25% were overweight with their BMI ≥25 kg/m^2 whiles 7.2% were underweight (BMI<18.5 kg/m^2). Clinically, there are various percentages of ailments especially severe body pains (60.4%) and headache (52.2%). Measured systolic blood pressures (≥140 mmHg) showed about 26% of men being hypertensive and biochemical examinations of Hb ≤13 g/dL indicating 18.8% of anaemic status (Table 2).

Binary logistic regression was used to examine the risk factors for Anaemia. The data showed significant association between anaemia and tobacco use (OR=16.39; 95% CI: 6.33 to 41.67) and the levels of dietary protein intake (OR=3.44; 95% CI: 1.53 to 7.69) (Table 3).

DISCUSSION

There is scanty information about haematological status of men in Ghana and over the world men health research are less important to researchers. This study indicated that

Table 2. Anthropometric, medical history and clinical indices (N=1449).

Variable	Age (Years; n (%))					
Age (Years)	**18-30**	**31-40**	**41-50**	**51-60**	**>60**	**Total n(%)**
Anthropometry BMI (kg/m^2)						
16.1-8.49 (underweight)	0	63 (14.8)	21 (6.7)	21 (10)	0	105(7.2)
18.5-24.9 (normal)	350(94.3)	217(50.8)	189(60)	147(70)	84(66.7)	987(68.1)
≥25 (overweight)	21 (5.7)	147(34.4)	105(33.3)	42 (20)	42 (33.3)	357(24.6)
Clinical examinations						
Abdominal	119(32.1)	231(54.1)	126(40)	84(40)	42(33.3)	602(41.5)
Anaemia	35(9.4)	0(0)	21(6.7)	21(10)	0(0)	11(5.3)
Body pain	203(54.7)	273(63.9)	147(46.7)	189(90)	63(50)	875 (60.4)
URI	189(50.9)	231(54.1)	84(26.7)	84(40)	42(33.3)	630(43.5)
ENT	0(0)	147(34.4)	42(13.3)	63(30)	21(16.7)	273(18.8)
Eye	35(9.4)	147(34.4)	42(13.3)	105(50)	42(33.3)	53(25.6)
Malaria	161(43.4)	217(50.8)	147(26.7)	42(20)	21(16.7)	588(40.6)
Oral	63(17)	42(9.8)	42(13.3)	63(30)	0(0)	210(14.5)
Headache	161(43.4)	259(60/7)	168(53.3)	147(70)	21(16.7)	756(52.2)
UTI	77(20.8)	84(19.7)	21(6.7)	21(10)	21(16.7)	224(15.5)
Skin	63(17)	63(14.8)	21(6.7)	63(30)	0(0)	210(14.5)
Blood pressure SBP (mmHg)						
≥140	21(5.7)	105(24.6)	42(13.3)	126(60)	84(66.7)	378(26.1)
Haemoglobin level (mg/dl)						
Hb ≤13	63(17)	84(19.7)	21(6.7)	63(30)	42(33.3)	273(18.8)

BMI= Body Mass Index; URI= Urinary Tract Infection; ENT= Ear Nose and Throat infections; UTI=Upper Respiratory Infections; SBP=Systolic Blood Pressure; Hb=Haemoglobin.

Table 3. Binary logistic regression for anaemia.

Variable	Unadjusted				*Adjusted		
	n	**Odds ratio**	**95%Cl**	**P-value**	**Odds ratio**	**95%Cl**	**P-value**
Age							
>40	93	1.06	0.47-1.89	0.86	-	-	-
≤40	114	1.00	Ref		-	-	-
Alcohol							
Yes	147	1.44	0.31-1.55	0.37	1.44	0.30-1.58	0.38
No	60	1.00	Ref	-	1.00	Ref	-
Tobacco							
Yes	46	10.64	3.70-23.26	<0.01	16.39	6.33-41.67	<0.01
No	161	1.00	Ref	-	1.00	Ref	-
Protein							
<60%	113	3.41	1.53-7.63	<0.01	3.44	1.53-7.69	<0.01
≥60%	94	1.00	Ref	-	1.00	Ref	-
Iron							
<60%	174	1.05	0.36-2.49	0.92	1.08	0.35-2.48	0.90
≥60%	33	1.00	Ref	-	1	Ref	-

Hb >13 g/dl=normal; ≤13g/dl=anaemia for men. *The multivariate logistic regression analyses model was adjusted for age, education, and all dietary nutrients assessed except iron and protein intakes.

about 18.8% of the participants were anaemic. Globally, men prevalence of anaemia stood at 5% (WHO, 2008; De Benoist et al., 2005; Gasche et al., 2007). The anaemia prevalence found in this study was far higher than global prevalence. This information shows limitation in the use of dietary analyses alone to determine the nutritional status of any individual or population. Because the dietary data indicated that about 84% of the men had sufficient iron in their diet and more than 54% had satisfactory intake of protein, these dietary data did not reflect in the men's haemoglobin levels. It implies that any effort to assess nutritional status by assessing dietary intake should be complemented with clinical and biochemical data. Another possible confounding factor could be that plant-based could prevent the availability of iron in the diet as well as, the essential amino acids.

The logistic regression to determine the risk factors for anaemia indicated that participants who used tobacco were about 16 times more likely to be anaemic as compared with non-users (Odds ratio:16.39, $p<0.01$). The poisonous alkaloid, nicotine found in tobacco smoke is an inhibitor to many ions in diet including iron. It also inhibits the absorption of many other digested nutrients in the gastro-intestinal tracts such as amino acids. These actions of nicotine may affect negatively the bio-availability of both iron and amino acids leading to anaemic conditions.

Cigarette smoking causes numerous diseases that are associated with anaemia but the resulting low haemoglobin levels may be counterbalanced by increased red blood cell production caused by chronic exposure to carbon monoxide from cigarette smoke. Diverse mechanisms are involved in influencing the development or the course of anaemic disease in smokers (Leifert, 2008).

A study discovered no significant difference in the mean hemoglobin levels between smokers and non-smokers. In that study, the mean hemoglobin levels rather increased progressively with the number of cigarettes consumed per day. Therefore, cigarette smoking appears to have caused a generalized upward shift of the haemoglobin levels, which decreases the usefulness of haemoglobin level to detect anemia in smokers. The study concludes that average haemoglobin values should be corrected for smokers to compensate for the concealing effect of smoking on the diagnosis of anemia among smokers (Nordenberg et al., 1990).

In another study, men did not show any difference in haemoglobin levels between smokers and non-smokers, but women smokers' haemoglobin levels significantly increased with age. Female smokers also exhibited a significant progressive association between number of cigarettes smoked per day and haemoglobin levels. It was revealed that people who smoke more than 10 cigarettes per day had significantly greater haemoglobin (1.4% higher in men and 3.5% higher in women) than non-smokers. The study concluded that tobacco smoking has an accumulative effect on haemoglobin levels in both sexes, which is proportionate to the amount of tobacco smoked per time. The effects seem to be more marked in females than males (Milman and Pedersen, 2009).

In the same model, men whose intake of protein were <60% NAR were about 3 (Odds ratio: 3.44, $p<0.01$) times more likely to be anaemic as compared with protein intake ≥60% NAR. It is a consequential that deficiency of protein would be followed by anaemia.

Protein is one of the main raw materials needed for synthesis of haemoglobin and the blood cells. It is also needed for transportation of iron in the form of transferrin, ferritin and haemosiderin. Protein is needed for protoporphyrin or porphyrin and globin which are required for synthesis of haemoglobin.

Conclusion

Lifestyle factors (tobacco smoking) and low intake of protein are risk factors for the incidence of anaemia in participating men. These findings raised important questions on the implications of tobacco use and habitual low protein intakes on erythropoiesis in poor communities. The need for nutrition and health advocacy to halt at least tobacco use in poor communities may be a step towards alleviating anaemia and promoting national development.

ACKNOWLEDGEMENTS

The authors wish to express their appreciation to the study participants, Chief/elders, Nurses, Pharmacy Assistants, Laboratory Technicians, Teaching/Research Assistants from the Department of Nutrition and Food Science, University of Ghana for their kind support in the course of this research.

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