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Original Article

Prevalence of Anaemia in adults with respect to Socio-Demographic status, Blood groups and religion in North Indian population

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ABSTRACT

Background: Anaemia is a common, multifactorial condition among adults and it is one of India's major public health problems. . The World Health Organization (WHO) definition of Anaemia (hemoglobin concentration <12 g/dL in women and <13 g/dL in men) is most often used in epidemiologic studies of adults. The prevalence of anaemia was found to range from 30% to 98% in different studies from different regions. **Objective:** The present study was designed to assess the prevalence of anaemia according to sex, Religion, blood group and their socio-demographic status among the apparently healthy young males and females from north Indian regions. **Materials and Methods:** The young population, both males and females with age group 20-50 years from north Indian, were studied for the prevalence of anaemia with respect to the religion, blood group and the socio-demographic status. **Results:** The prevalence of anaemia in females (20-50 years) was 70.1%, which included 48.7% of mild, 19.9% of moderate and 1.5% of severe anaemia cases. The prevalence of anaemia in Males (20-50 years) was 53.2%, with 34.3% suffering from mild, 17.7% from moderate and 1.2% from severe anaemia. Both males and females were in the younger age group, who belonged to a lower socio-economic status, lower socio-demographical status and a low activity life style, had a higher prevalence of anaemia. **Conclusions:** The present study found a high prevalence of Anaemia in both males and females in north Indian population, thus indicating that the problem of anaemia was related to a wider population than the traditional groups of the pregnant and lactating females and children. Large population studies are needed to find out the cause and the type of anaemia along with other risk factors in all the age groups, irrespective of sex.

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1. Introduction

Anaemia is a global public health problem affecting both developing and developed countries with major consequences for human health as well as social and economic development. It occurs at all stages of the life cycle, but is more prevalent in pregnant women and young children. In 2002, iron deficiency anaemia (IDA) was considered to be among the most important contributing factors to the global burden of disease [1]. Anaemia is the result of a

wide variety of causes that can be isolated, but more often coexist. Globally, the most significant

Contributor to the onset of anaemia is iron deficiency so that IDA and anaemia are often used synonymously, and the prevalence of anaemia has often been used as a proxy for IDA. It is generally assumed that 50% of the cases of anaemia are due to iron deficiency, but the proportion may vary among population groups and in different areas according to the local conditions [2]. The main risk factors for IDA include a low intake of iron, poor absorption of iron from diets high in phytate or phenolic compounds, and period of life when iron requirements are especially high (i.e. growth and pregnancy). Among the other causes of Anaemia, heavy blood loss as a result of menstruation, or

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parasite infections such as hookworms, ascaris, and schistosomiasis can lower blood haemoglobin (Hb) concentrations. Acute and chronic infections, including malaria, cancer, tuberculosis, and HIV can also lower blood Hb concentrations. The presence of other micronutrient deficiencies, including vitamins A and B12, folate, riboflavin, and copper can increase the risk of anaemia. Furthermore, the impact of haemoglobinopathies on anaemia prevalence needs to be considered within some populations. Anaemia is an indicator of both poor nutrition and poor health. The most dramatic health effects of anaemia, i.e., increased risk of maternal and child mortality due to severe anaemia, have been well documented [3-5].

In the adult population, anaemia is a risk factor for cardiovascular health and early death. In addition, it also causes fatigue and leads to negative impact on cognitive and physical functions as well as on the quality of life [6]. Most of the existing studies point out that anaemia among women causes increased risk of low birth weight, inadequate iron stores for the newborn, higher risk of maternal morbidity and mortality as well as a decline in mental concentration and physical activity [7, 8]. Although it was believed that a decline in haemoglobin levels might be a normal consequence of ageing, evidence has accumulated that anaemia does reflect poor health and increased vulnerability to adverse outcomes in older persons [9]. As the elderly population is rising, the prevalence of anaemia is also expected to rise sharply in the future. Prevalence of anaemia in South Asia is among the highest in the world, reflecting overall high rates of malnutrition [10]. Numerous studies have evaluated prevalence of anaemia among pre-school children [11]; adolescents [12, 13]; pregnant and lactating women [8, 14].

In the developing world, 42% of children less than five years of age and 53% of children 5-14 years of age are anaemic [15]. Anaemia has been related to reduce work capacity, reduced ability to execute activities of daily living, poor pregnancy outcomes, and reduced cognitive function [16-20]. With limited resources and the complex, often multi-factorial nature of Anaemia in the developing world, combating this problem is a global public health challenge [21]. Anaemia is defined as a condition where there is less than the normal hemoglobin (Hb) level in the body, which decreases oxygen-carrying capacity. World Health Organization (WHO) definitions for Anaemia differ by age, sex, and pregnancy status as follows: for children 6 months to 5 years of age Anaemia is defined as a Hb level < 11g/dL, children 5-11 years of age Hb < 11.5 g/dL, adults males Hb < 13 g/dL; non-pregnant females Hb < 12g/dL, and pregnant females Hb < 11g/dL[22]. Severe Anaemia is defined as Hb < 7.0 g/dL [22]. Because iron deficiency Anaemia is the leading cause of Anaemia in the developing world, Anaemia and iron deficiency Anaemia are often used interchangeably. There are, however, mild-to-moderate forms of iron deficiency in which the host is not yet anemic, but tissues are functionally iron deficient [23]. In addition, although iron deficiency accounts for most of the Anaemia that occurs in underprivileged environments, multiple other causes exist independently or coexistent with this micro-nutrient deficiency.

India is facing a grave public health problem, with the prevalence of anaemia in India being > 40%. Anaemia is an indicator of poor nutrition and poor health with major consequences for the human health, as well as for the social and economic development of a population, more studies was done in context to Anaemia and Socio demographical status but not any study was done which shows the correlation with Anaemia, religion and blood group. However Study the Prevalence of Anaemia in adults with Respect to socio-demographic Status, Blood group and religion in north Indian population.

2. Materials and Methods:

2.1 Study Design:

This is a prospective cross-sectional study, conducted in north Indian population with age between 20-50 years. We selected 609 (six hundred and nine) individuals from the community by random numbers for blood sampling. A structured Performa was filled by each subject to collect the information regarding their personal, family, medical, as well as dietary history. The study was approved by the ethical committee of our institute and by the Council of science and Technology Lucknow Uttar Pradesh and "we certify that all applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during this research". Written informed consent was obtained from all the participants. This study was conducted under the principles of the Declaration of Helsinki. Hemoglobin estimation of all 609 individual was done by sahlis method. Anaemia was defined as the hemoglobin of less than 13 g/dl in males and less than 12 g/dl in females [24, 25]. Mild Anaemia was defined as hemoglobin level of 10-12.9 g/dL in males and 10-11.9 g/dL in females, moderate Anaemia was defined as hemoglobin level of 7-9.9 g/dL and severe Anaemia was defined as hemoglobin level of less than 7g/dL both among males and females respectively [26]. The socioeconomic status was based on total family income per month. Hb levels vary by age and many laboratories use adult norms as references; therefore, the patient's Hb level must be compared with age-based norms to diagnose Anaemia.

2.2. Statistical analysis: The statistical analysis was performed using INSTAT 3.0 [41] (Graph Pad Software, San Diego, CA). Results are expressed as the Chi square and Fischer's exact test were used as applicable. Multivariate analysis was performed to determine the correlation between degree of hemoglobin levels and the other continuous variables. Association between anemic non anemic and socio-demographical examination with unpaired chi square test. A value of $P < 0.0001$ was considered to be statistically significant.

3. Result

The prevalence of anaemia in adult male and females in the age group of 20-50 years (n-609) with respect to the age, activity profile and socio-demographic status in north Indian population has been presented in (Table-1,2&3). The prevalence of anaemia in young females in our study was 70.1%, which included 48.7% mild, 19.9% moderate and 1.5% severe anaemia cases. The Prevalence

of anaemia was 29.32% among younger females of the age group of 20-29 years (n-266), 27.44% in the age group of 30-39 years and 13.53% in the age group of 40-50 years.

Table 3; Gender Specific Multivariable binary logistic regression analysis of the confounding variables

Hb (g/dl) (N=609)	Hb of >12gm%	Total	Hb of <12gm%			χ^2 , df,p
			Mild	Moderate	Severe	
Female(N=266)	79(29.9)	186(70.1)	130(48.7)	53(19.9)	4(1.5)	17.762,1,<0.0001
Male(N=343)	160(46.8)	183(53.2)	118(34.3)	61(17.7)	4(1.2)	

Mild=11.9-10 in Female, 12.9-10 in male, Moderate=9.9-7 in both, Severe=<7 in both

Table- 2: Prevalence of Anaemia in male and female in north India according to age group

Hb (g/dl)in	Hb of >12gm%	Total	Hb of <12gm%			χ^2 , df,p
			Mild	Moderate	Severe	
Female Age group (N=266)						
20-29	23(8.65)	78(29.32)	60(22.56)	17(6.39)	1(0.38)	19.524,2,<0.0001
30-39	20(7.52)	73(27.44)	45(16.92)	25(9.39)	3(1.13)	
40-50	36(13.53)	36(13.53)	25(9.39)	11(4.14)	0	
Male Age group (N=343)						
20-29	22(6.41)	67(19.53)	44(12.83)	21(6.12)	2(0.58)	23.598,1,<0.0001
30-39	78(22.74)	70(20.40)	42(12.24)	28(8.16)	0(00.0)	
40-50	60(17.49)	46(13.41)	32(9.33)	12(3.49)	2(0.58)	

The prevalence of anaemia in adult males in our study was 53.2%, which included 34.3% mild, 17.7% moderate and 1.2% severe anaemia cases. The Prevalence of anaemia was 19.53% among adult males of the age group of 20-29 years, 20.40% in the age group of 30-39 years and 13.41% in the age group of 40-50 years. The prevalence of Anaemia in males in both the age groups of 20-29 years (n-89) and 30-39 years (n- 148) was almost similar; that is 19.53% and 20.40% respectively.

The prevalence of Anaemia was significantly related with type of family and family size. Prevalence of Anaemia was higher in family size more than three (2.63%) and lower in family size less than three (9.69%). In the present study prevalence of Anaemia was higher in nuclear family (33.49%) in compare to the joint family (18.06%).

The prevalence of Anaemia was higher in Socio-economic class III 119 (19.54%), Socio-economic class II (11.17%) and lower in class I (3.61%). Degree of Anaemia was higher in High school level (12.81%) and lowest in Graduation level (3.94%).

The prevalence of Anaemia not shows significant correlation with religion among (n-609) 239(39.24%) were Hindu which includes 22% anemic and 17.24% non anemic, Muslims 183 (30.05%) in which 95(15.60%) anemic and 14.44% non anemic, Christians 50(8.21%) in which 3.28% anemic & 4.92% non anemic, Shikh 90 (14.78%) in which 6.9% anemic & 7.88% non anemic and Jains 47 (7.72%) in which 3.78% anemic & 3.94% non anemic.

The overall frequencies of the various hemoglobin ABO blood groups in this study are shown in table 3. of the 609 subject screened, 13.3% were of blood group A, 39.24% blood group B, 5.25% blood group AB, and 42.20% group O. The prevalence of Anaemia is higher in blood group B and blood group O which is 18.88% and 22.18% respectively.

Table-3: Socio-demographic correlates and prevalence of Anaemia in north Indian population

Socio-demographic correlates	No of cases (N=609)	Anemic cases Number(314)	Anemic cases prevalence	χ^2 , df,p
Type of Family				
Nuclear	321(52.71)	204	33.49	38.072,1,<0.0001
Joint	288(47.29)	110	18.06	
Socio-economic Class				
I	57(9.36)	22	3.61	13.536,4,<0.0089
II	140(22.99)	68	11.17	
III	244(40.07)	119	19.54	
IV	96(15.76)	58	9.52	
V	72(11.82)	47	7.72	
Family Size				
<or=3	214(35.13)	59	9.69	6.666,1,<0.0098
>3	395(64.86)	150	24.63	
Educational status				
Illiterate	50(8.21)	37	6.08	144.4,6,<0.0001
Just literate	53(8.70)	41	6.73	
Primary	80(13.13)	57	9.36	
Middle	95(15.60)	78	12.81	
High School	89(14.61)	41	6.73	
Sr.secondary	130(21.35)	36	5.91	
Graduation	113(18.56)	24	3.94	
Religion				
Hindu	239(39.24)	134	22.00	8.943,3,0.0301
Muslim	183(30.05)	95	15.60	
Christian	50(8.21)	20	3.28	
Sikh	90(14.78)	42	6.90	
Jain	47(7.72)	23	3.78	
Blood groups				
A	81(13.3)	52	8.54	
B	239(39.24)	115	18.88	
AB	32(5.25)	12	1.97	
O	257(42.2)	135	22.18	

Fig-1 Percentage Anaemia in male and female in north Indian

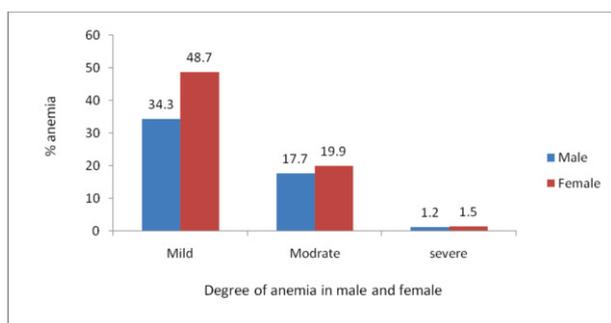


Fig-5: Prevalence of Anaemia according to religion in north Indian adults

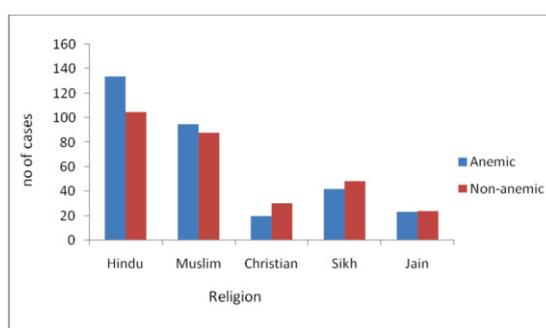
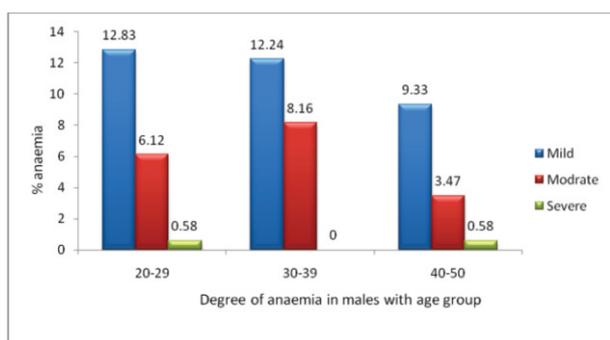


Fig-2 Percentage Anaemia in males in north Indian adults



4. Discussion

In our study, the overall prevalence of Anaemia was 70.1%, in females and 53.2%, males, which was more than the global prevalence. In the present study the prevalence of mild Anaemia was 48.7%, moderate Anaemia was 19.9% and severe Anaemia was 1.5%, with a total prevalence of 70.1% among females in the age group of 20-50 years. In a study among the adolescent girls of Nepal, the prevalence of Anaemia (68.8%) was found to be lower than the Indian females in the present study (70.1%). [27] The highest prevalence of Anaemia was found in Jharkhand State, where almost all the adolescent girls were anemic which was more as compared to the findings of our study[28]. In our study, the prevalence of Anaemia among males (20-50 years) was 53.2%, which was more as compared to NFHS 3 data 24% [29]. In another study, the prevalence of Anaemia in the 16-70 years age group among males was 44.3% [30]. The present study highlights a higher prevalence of Anaemia in males as compared to previous data. In a study on Prevalence of anaemia amongst women in the reproductive age group in a rural area in south India Raghuram v, Manjula Anil, Jayaram S Anaemia was found in the age group of 31-35 constituted 25.9% while those in the age group of 26-30 constituted 21.4%. Muslims constituted 51.4% while Hindus constituted 44.8%. Among 155 women surveyed 66.6% had received primary education. 87% of the women surveyed were married. 64.5% of study population belonged to upper middle class of Modified Prasad's classification [31].

Fig-3: Percentage Anaemia in female in north India according to age group

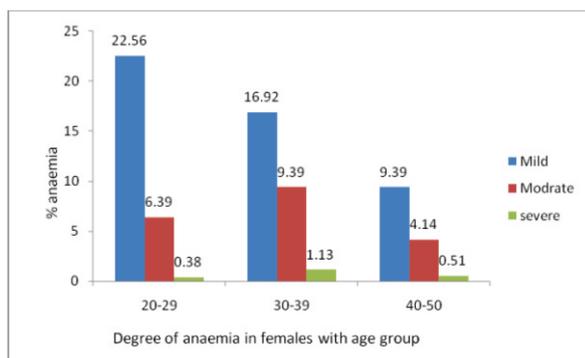
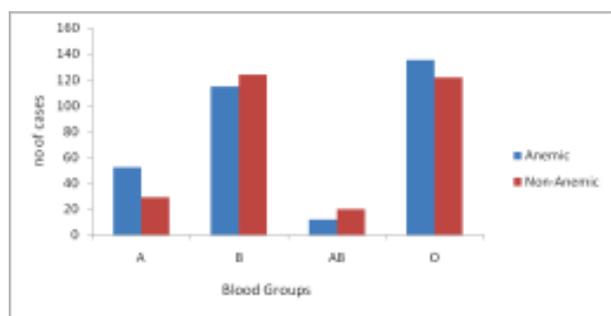


Fig-4: Prevalence of Anaemia and blood group in north Indian adults



In our study the prevalence of Anaemia both male and female was higher in socio-economic class III (19.54%) and lower in socio-economic class II (3.61%). In a study Rawat et al reported The prevalence of anaemia was 49.2 per cent among the adolescent girls in scheduled castes as against 36.7 per cent in other backward class and 31.4 per cent in savarna Hindus which is comparable to the study by Rawat et al on adolescents girls in rural area of Meerut [32].

The present study prevalence of Anaemia was related with type of family and family size, However severity of Anaemia was significantly higher in nuclear family (33.49%) and lower in joint family (18.06%). It may be the prevalence of Anaemia was higher

in nuclear family because no of cases were more in nuclear family. In a study of Rawat et al reported anaemia was significantly higher (45.2%) among the adolescent girls belonging to joint families as compared to (28.3%) those from nuclear families ($p < 0.001$), which may be due to availability of quantitatively and qualitatively adequate food in nuclear families [33].

In our study the prevalence of Anaemia was higher in family size >3 (24.63%) and lower in family size <3 (9.69%). In a study Rawat, S.K. Garg, et al found a similar pattern, higher prevalence of anaemia ($p < 0.02$) in adolescent girls belonging to families having family size >3 than those girls from families of family size <3 may be due to availability of adequate diet to all the family members in small families [33].

In our study there were not significant correlation with the prevalence of Anaemia and blood groups. The prevalence of Anaemia is higher in blood group O (22.18%), blood group B (18.88%) and lower in blood group AB (5.25%) and A (13.3%). It may be the prevalence of Anaemia was higher in blood group O (22.18%) because no of cases were more of blood group O. The ABO blood group system in the total sample showed the same trend of prevalence as for the general Indian subcontinent ($B > O > A > AB$). In a study Khaliq et (2009) same trend was found among males, but among females the order of was different ($O > B > A > AB$) in Jammu and Kashmir. However, the allelic frequencies in both sexes were in the order of $O > B > A$ [34]. Another reason which we did not explore was the type of diet which was consumed by the study population, as evidence indicated a higher prevalence of anaemia among children who had a vegetarian diet, because vegetarian diets are a poor source of iron [35, 36]. Verma et al also found a higher prevalence of anaemia among the vegetarian than the non-vegetarian schoolgirls (66% vs. 38%) [37]. In developing countries such as India, the poor bio-availability of dietary iron, coupled with a low intake of iron which was derived from animal foods, is a major aetiological factor for anaemia [38]. The present study thus brings out the fact that the problem of Anaemia was related to a wider population than the traditionally considered groups of the pregnant females, lactating females and children. Studies have shown that Anaemia was an indicator of poor nutrition and poor health, with major consequences on the human health as well as on the social and economic development [39, 40].

In our study the prevalence of anaemia in young males and females in north Indian population was relatively higher as compared to the national standards. Our study highlights the fact that the prevalence of anaemia was more in the younger age groups, in the lower socio-economic groups and in subjects with a sedentary life style. We suggest that there is a need for well planned, systematic and large-scale studies by using standardized methodologies to estimate the prevalence of anaemia as well as the cause of anaemia at the community level among males and females in all age groups, with an accurate evaluation of the socio-economic status and the representation of the different regions of India. A comprehensive study, including anthropometric data,

biochemical data, clinical signs and dietary intake data will give a better insight into the situation and more importantly, it will help in devising interventions for the prevention and the treatment of anaemia, which should be directed towards all members of the community, irrespective of age and sex.

5. Conclusion

The present study found a high prevalence of anaemia in both males and females in the north Indian population, thus indicating that the problem of anaemia was related to a wider population than the traditional groups of the pregnant and lactating females and children. In fact Anaemia is a basic predictor of many diseases; therefore larger study will be conducted to know the actual prevalence of Anaemia at national level.

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6. Reference

- [1] World Health Organization: Reducing risks, promoting healthy life; The World Health Report 2002.
- [2] A guide for programme managers; Iron deficiency anaemia: assessment, prevention, and control. Geneva, World Health Organization, 2001 (WHO/NHD/01.3). *Scottish Medical Journal*, 1963, 8:134.
- [3] Geneva, World Health Organization, Macgregor M. Maternal anaemia as a factor in prematurity and perinatal mortality 2002.
- [4] Scholl TO, Hediger ML. Anaemia and iron-deficiency Anaemia: compilation of data on pregnancy outcome. *American Journal of Clinical Nutrition*, 1994, 59:492S-500S.
- [5] Bothwell T, Charlton R, eds. Iron deficiency in women. Washington DC, Nutrition Foundation, 1981.
- [6] Gabrilove J. Anaemia and the elderly: clinical considerations. *Best Pract Res Clin Haematol* 2005, 18 (3): 417-422.
- [7] Gillespie S & Johnston J; Expert Consultation on Anaemia Determinant and Interventions. Ottawa: The Micronutrients Initiatives (1998).
- [8] Toteja GS, Singh P, Dhillon BS, Saxena BN, Ahmed FU & Singh RP. Prevalence of Anaemia amongst pregnant women and adolescent girls in 16 districts of India. *Food Nutr Bull* 2006, 27: 311- 5.
- [9] Guralnik MJ, Eisenstaedt RS, Ferrucci L, Klein H & Gand Woodman RC. Prevalence of Anaemia in persons 65 years and older in the United States: evidence for a high rate of unexplained Anaemia. *Blood* 2004, 104 (8): 2263-68.
- [10] Bentley ME & Griffiths PL. The burden of Anaemia among women in India. *Eur J Clin Nutr* 2003, 57(1): 52-60.
- [11] Vendt N, Grunberg H, Leedo S, Tillmann V & Talvik T. Prevalence and causes of iron deficiency Anaemia in infants aged 9 to 12 months in Estonia. *MEDICINA (Kaunas)* 2007, 43 (12): 947-52.
- [12] Kaur S, Deshmukh PR & Garg BS. Epidemiological correlates of nutritional Anaemia in adolescent girls of rural Wardha. *Indian J Comm Med* 2006, 31 (4): 255-258.
- [13] Gautam VP, Taneja DK, Sharma N, Gupta VK & Ingle GK. Dietary aspects of pregnant women in rural areas of Northern India. *Matern Child Nutr* 2008, 4 (2): 86-94.

- [14] Gautam VP, Taneja DK, Sharma N, Gupta VK & Ingle GK. Dietary aspects of pregnant women in rural areas of Northern India. *Matern Child Nutr* 2008; 4 (2): 86-94.
- [15] Administrative Committee on Coordination/Standing Committee on Nutrition, ACC/SCN, 2000. Fourth Report on the World Nutrition Situation. New York: United Nations.
- [16] Haas JD, Brownlie TT. Iron deficiency and reduced work capacity: a critical review of the research to determine a causal relationship. *J Nutr* 2001; 131: 676S-688S.
- [17] Sabbatini P. The relationship between Anaemia and quality of life in cancer patients. *Oncologist* 5 (Suppl 2): 2000, 19-23.
- [18] Allen LH. Anaemia and iron deficiency: effects on pregnancy outcome. *Am J Clin Nutr* 2000; 71: 1280S-1284S.
- [19] Stivelman JC. Benefits of anaemia treatment on cognitive function. *Nephrol Dial Transplant* 15 (Suppl 3): 2000, 29-35.
- [20] Nelson M. Anaemia in adolescent girls: effects on cognitive function and activity. *Proc Nutr Soc* 1996; 55: 359-367.
- [21] Yip R, Ramakrishnan U. Experiences and challenges in developing countries. *J Nutr* 2002; 132: 827S-830S.
- [22] World Health Organization. Iron Deficiency Anaemia: Assessment, Prevention and Control. Geneva: World Health Organization 2001.
- [23] Bruner AB, Joffe A, Duggan AK, Casella JF, Brandt J. Randomised study of cognitive effects of iron supplementation in non-anaemic iron-deficient adolescent girls. *Lancet*, 1996; 348: 992-996
- [24] National consultation on control of nutritional Anaemia in India. Department of Family Welfare (Maternal Health Division), Ministry of Health and Family Welfare, Nirman Bhawan, New Delhi, 1998.
- [25] Seshadri S. A database on iron deficiency Anaemia (IDA) in India: prevalence, causes, consequences and strategies for prevention. Department of Foods and Nutrition. WHO Collaborating Centre for Nutrition Research. The Maharaja Sayajirao University of Baroda, Vadodara, India, 1999.
- [26] Malhotra P, Kumari S, Kumar R, Ganguly NK, Jain S, Sharma BK. Hypertension and insulin resistance in a native unindustrialised rural population of India. *Int J Cardiol* 1998; 65: 91-9.
- [27] Shah BK, Gupta P. Weekly vs daily iron and folic acid supplementation in adolescent Nepalese girls. 2002; 156: 131-5.
- [28] Census of India. Provisional population totals. Registrar-General and Census Commissioner. New Delhi: Government of India, 2001.
- [29] National Family Health Survey (NFHS-3): India: Volume I. Mumbai: 2005-06; IIPS. available on: <http://www.nfhsindia.org/nfhs3.html>
- [30] Malhotra P, Savita Kumari et al. Prevalence of anaemia in an adult rural population of North India. *JAPI*, January 2004; 52.
- [31] Raghuram V, Manjula Anil, Jayaram S : Prevalence of anaemia amongst women in the reproductive age group in a rural area in south india *Int J Biol Med Res.* 2012; 3(2):1482-1484
- [32] Rawat C.M.S. An Epidemiological Study of Anaemia in Adolescent Girls in the Rural Area of Meerut; 2000: (Thesis submitted for M.D. in Community Medicine, C.C.S. University, Meerut).
- [33] C.M.S. Rawat, S.K. Garg, J.V. Singh, M. Bhatnagar, H. Chopra, S.K. Bajpai: Socio-Demographic Correlates of Anaemia Among Adolescent Girls in Rural Area of District Meerut (U.P.) (2001-10 - 2001-12); Vol. 26, No. 4
- [34] Khan MN, Khaliq I, Bakhsh A, Akhtar MS, Amin-ud-Din M.: Distribution of ABO and Rh D blood groups in the population of Poonch District, Azad Jammu and Kashmir. *East Mediterr Health J.* 2009 May-Jun; 15(3):717-21.
- [35] Christoffel K. A pediatric perspective on vegetarian nutrition. *Clin Pediatr* 1981; 20: 632-43.
- [36] Dagnelie PC, Staveran WA, Vergote FJ, DingJan PG, Berg H, Hautvast JG et al. Increased risk of vitamin B12 and iron deficiency in infants on macrobiotic diets. *Am J Clin Nutr* 1989; 50: 818-24.
- [37] Verma M, Chhatwal J, Kaur G. Prevalence of anaemia among urban school children of Punjab. *Indian Pediatrics* 1999; 36: 1181-86.
- [38] Kaur S, Deshmukh PR, Garg BS. Epidemiological correlates of nutritional anaemia in adolescent girls of rural Wardha. *Indian J Community Med* 2006; 31: 255-58.
- [39] Grantham-McGregor S, Ani C. A review of studies on the effect of iron deficiency on cognitive development in children. *J Nutr* 2001; 131: 649S-666S; discussion 666S-668S.
- [40] Schauer C, Zlotkin S. Home fortification with micronutrient sprinkles - a new approach for the prevention and treatment of nutritional anaemias. *Paediatr Child Health* 2003; 8: 87-90.
- [41] John Wass. Software: Statistics, fast and easy. Science; 27 November 1998: Vol. 282. No. 5394, p. 1652