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ORIGINAL ARTICLE

An analytical cross-sectional study on the determinants of nutritional anemia among children aged 1 to 5 years from Muzaffarnagar, India

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Abstract

Background: Nutritional anemia, one of the common causes of anemia, may result from the deficiency of a number of micronutrients. The present study was conducted to assess the prevalence of nutritional anemia and the clinico-haematological profile of anemia among the hospitalized children aged 1 to 5 years.

Materials and Methods: A cross sectional study was conducted among 250 anemic children between age one and five years attending the tertiary care hospital at Northern India. An interviewer administered questionnaire was used to obtain the data. Peripheral blood samples were used to assess the hematological parameters.

Results: The prevalence of nutritional anemia among the anemic 1-5 years old children was 27.6%, in which Iron deficiency anemia (IDA) prevalence was 21.2%. Vitamin B12 deficiency was found among 8% of the anemic children and folic acid deficiency was prevalent among the 1.6% of the cases. The mean hemoglobin levels were significantly lower in among the nutritional anemia children (8.75 g/dl).

Conclusion: Overall, the proportion of nutritional anemia among children aged one to five years is significant in Northern India, with IDA being the most common nutritional deficiency anemia.

Keywords: nutritional anemia; iron deficiency anemia; child; prevalence; India

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Introduction

Despite the fact that anemia is largely preventable and easily curable, it remains a widespread health concern, especially in developing countries like India. In spite of economic prosperity and preventative measures, it remains a serious public health problem and a major reason for death and morbidity in children. It has been estimated that, globally 1.8 billion people are anemic, with children below 10 years of age bearing major brunt of this problem [1]. Anemia is thought to affect roughly 20.0% of children under the age of five in industrialised nations and 39.0% of children in non-industrialized nations [2]. Earlier estimates had reported that in developing nations, anemia affects up to 51.0% of children aged 0 to 4 and 46.0% of children aged 5 to 12 years [3,4]. Globally, the World Health Organization (WHO) reported the highest anemia prevalence (42%) among the children who are below the age of five years [5]. More specifically, children in the age between 6 and 59 months had an anemia prevalence of 39.8%, which translated to 269 million children in terms of absolute numbers [6]. Indian scenario is worse than the global picture with regards to the anemia. The National Family Health Survey of India in its latest round of results (5^{th} round), reported a 67.1% prevalence of anemia among the children between the age group 6 months and 59 months [7]. The most prevalent morbidity, anemia, has a negative impact on the health, productivity, and economics of the whole country [8].

Children's anemia is different from adult anemia since it usually manifests earlier and worsens at a rapid pace. Children's growth, development, well-being, and academic achievement are all profoundly impacted by anemia. Children's appetites are affected, which has an adverse effect on nutrition, and a vicious cycle is set in motion, making the issue worse. Children who are hospitalised often have co-morbid conditions, which may lengthen hospital stays, increase the risk of complications, and necessitate the need for blood transfusions [9].

Nutritional anemia, one of the common causes of anemia, may result from the deficiency of a number of micronutrients. The phrase "nutritional anemia" refers to any clinical disorders in which a nutrient shortage causes the blood haemoglobin concentration to fall to an abnormally low level. Iron, folic acid, and vitamin B12 are the principal nutrients necessary for the formation of haemoglobin. The most prevalent yet avoidable dietary deficit especially in children is the major cause for this morbidity. In terms of global public health, lack of iron is the primary cause of nutrition related anemia. Folic acid insufficiency is less common and usually present in conjunction with iron deficiency. Lack of vitamin B12 is relatively rare [8]. The majority of instances of anemia are caused by iron deficiency and proceed gradually. Iron deficiency anemia affects 30.0% of the world's population, according to the prevalence of anemia [10], with an annual incidence of 4-5 million cases [11].

The overall increased morbidity in children may be attributed to nutritional anemia, which can cause a number of physical and mental diseases. Because the anemic child is susceptible to infections and may fall into the vicious cycle of malnutrition-infection-malnutrition, it is a dangerous disorder in the paediatric age range. Additionally, it may have an impact on the child's general mental and motor development [2]. The false belief that there are no feasible and effective therapies has often limited efforts and projects to prevent and manage anemia. Nutritional anemia is easily preventable and inexpensive to cure.

Population-based data on the prevalence of anemia among the children below five years are available for India. However, data on the hematological attributes and the associated factors in hospitalized children are limited, especially in the current settings of Northern India. Hence, we conducted the following study to assess the prevalence of nutritional anemia and their clinico-haematological profile among the hospitalized anemic children aged 1 to 5 years.

Materials and Methods

Study design: Hospital based cross sectional study

Study Period: January 2021 to July 2022

Study Population: Children belonging to the ages between one and five years who were admitted to the inpatient department of a pediatric ward at Muzaffarnagar medical college, and whose hemoglobin levels were less than or equal to 11 gm/dl were included. Children with any chronic disease or had been transfused with blood in the last 3 months or received any hematinics in last three months were not included.

Sample Size: According to the prevalence of nutritional anemia among the children aged 1-4 years as 68.9% from a survey [12], taking a relative error of 10%, at 95% confidence interval, a minimum sample size of 228 was calculated. Adding 10% non-completion rate/missing data, a sample size of 251 anemia children was calculated.

Sampling technique: Consecutive sampling with complete enumeration of all eligible children till the sample size was achieved.

The major outcomes are the prevalence of nutritional anemia, hematological profile of nutrition anemia children and the determinants of nutritional anemia.

Data collection

After obtaining the parent's or the child's legally recognised representative's signed informed consent, anemic children in inpatient departments who satisfy the inclusion criteria were inducted into the study. An interviewer administered bilingual (English & Hindi) questionnaire was used to obtain the data on the socio-demography, feeding practices and the infection history of children, from the attendants who brought the child. Additionally performed were a thorough history, examination of the child, anthropometry, as well as a systemic examination according to a predesigned proforma. Age of the child was recorded in completed months. Peripheral blood samples were drawn under aseptic conditions and submitted for investigation of the complete blood count, peripheral smear, serum iron indices, folic acid, serum vitamin B12 levels and other hematological indices. Nutritional anemia is determined based on the serum levels of vitamin B12 (less than 203 pg/ml), folate (less than 4 ng/ml) and ferritin levels (less than 12 mcg/L).

Data analysis

Data was entered in MS excel. Analysis was conducted in SPSS 26.0. Categorical variables were expressed in frequencies and proportions. Normality of Continuous variables were tested (Kolmogorov Smirnov test) and data was assessed to be not normally distributed. Mann-Whitney test was applied to test the association between continuous variables and nutritional anemia status. To investigate the relationship between categorical variables, the chi-square test was applied. Spearman correlation was used to test the association between serum ferritin, vitamin B12, folic acid levels and the hematological indices. Statistical significance was taken as a p value below 0.05.

Ethical review

The study didn't include any experimentation. Informed consent was gained after fully explaining the study purpose and process to the child attendants (parents/guardians). No monetary or personal benefits from commercial bodies were provided to anybody involved in the study. Ethics approval for the study was taken from the institution ethics committee before the start of the research. Confidentiality of the data was maintained.

Results & Discussion

Anemia is still a major public health issue on a worldwide scale. Nutritional anemia is a

major cause of morbidity and economic burden across the globe, especially in the lower- and middle-income countries. Epidemiological characteristics and determinants of the nutritional anemia will enable the policy makers in better formulation of the strategies to manage it. The present study was undertaken in a tertiary care institutional settings in Northern India to evaluate the burden, clinical and hematological features of the nutritional anemia among the children between one and five years of age. The total number of anemic children who were enrolled and completed the study was 250 (response rate of 99.60%).

The prevalence of nutritional anemia among the anemic 1–5 years old children was 27.6%, with Iron deficiency anemia (IDA) accounting for three fourth of the nutritional anemia cases (21.2%). This is similar to the prevalence of IDA reported from Ethiopia (25%) among children aged between two and five years [13]. In contrast, Levin et al reported lower prevalence of iron deficiency anemia among their children (5.8%) [14]. Although iron deficiency anemia affects people across the age group, children are one of the most vulnerable groups for this deficiency anemia [15].

The mean age of the nutritional and non-nutritional anemic children included in our study was 38.32 and 38.55 months, respectively. Among the children with nutritional anemia, there was similar proportion of males (50.7%) and females, while majority were in the age group of 48-60 months. The mean BMI of children with nutritional anemia was 13.77 kg/m^2. (Table 1).

Various hematological and micronutrients levels of the children with nutritional anemia are enumerated in Table 1. The mean ferritin and iron level among the nutritional anemia children was 13.88 ug/L and 34.71 ug/dl, respectively. Levin et al reported a lower ferritin levels of 6.58 ng/dl among the children between 18 and 36 months with iron deficiency anemia in their study from Israel [14]. Children with nutritional anemia in the index study had a significantly lower PCV, MCV, MCH, platelet count, transferrin saturation, serum iron and ferritin, while they had significantly higher RDW and TIBC. This is in line with findings from the past research which had reported a similar relationship of these indices with the iron deficiency anemia.[16] Levin et al reported significantly lower ferritin among the iron deficient anemic children than the other anemia [14]. The mean hemoglobin levels were significantly lower in among the nutritional anemia children (8.75 g/dl) in the present study, indicating the higher severity of anemia due to nutritional deficiency. (Table 1)

While Vitamin B12 deficiency was found among 8% of the anemic children, folic acid deficiency was prevalent among the 1.6% of the cases. This distribution of megaloblastic anemia is in line with the findings of previous study from India, where Vitamin B12 was relatively more prevalent than folate deficiency [17]. In contrast, Umasanker et al reported much higher prevalence of Vitamin B12 deficiency (64.8%) among the clinically determined anemic children [18]. The mean vitamin B12 and Folic acid levels were 452.03 pg/ml and 19.69 ng/ml, among the children with nutritional anemia in our study. Umasanker et al reported lower Vitamin B12 levels than our study (189 pmol/L) [18]. Tetrahydrofolate, an essential component of DNA synthesis, can only be produced by the body when vitamin B12 is present [19]. If left untreated, vitamin B12 insufficiency in children is a serious, treatable public health issue that might have long-term neurological effects [18,20]. The dietary practices and history of these children would have given an explanatory picture, since Vitamin B12 deficiency is associated with decreased intake of animal diet. Concurrent deficiency of Iron as well as Vitamin B12 was diagnosed among 2.8% of the children in the index study. Such a combined deficiency has been reported to present as delayed puberty in the later stages of child [19].

Table 1: Association between the nutritional anemia and the demographic, clinical and hematological parameters (N=250)

Variable	**Nutritional Anemia**				p value*
	Yes (69)		**No (181)**		
	Mean	**SD**	**Mean**	**SD**	
Age (months)	38.32	16.46	38.55	15.02	0.658
Height (cm)	92.83	11.47	93.07	9.58	0.872
Weight (kg)	11.92	2.99	11.71	2.45	0.721
BMI	13.77	2.14	14.25	10.06	0.390
Hb (g/dl)	8.75	1.32	9.55	1.13	**<0.001**
TLC (cells/cu.mm)	11094.20	4592.09	10295.03	4557.49	0.219
RBC(millions/cu.mm)	4.52	0.76	4.42	0.51	0.052
PCV (%)	29.16	8.55	31.42	4.48	**<0.001**
MCV (fL)	64.23	9.95	69.05	15.32	**<0.001**
MCH (pg)	20.56	5.84	21.98	3.36	**0.002**
MCHC (%)	30.59	2.32	33.01	20.98	0.462
RDW (%)	16.32	3.53	14.93	3.49	**0.001**
Platelet count(cells/cu.mm)	3.83	1.61	4.05	6.53	**0.004**
Reticulocyte count (%)	0.91	0.84	0.82	0.47	0.729
TIBC (umol/L)	407.52	92.49	321.01	91.86	**<0.001**
Transferrin saturation(%)	8.42	4.97	14.28	11.60	**<0.001**
S. Transferrin (mg/dl)	442.17	86.91	369.09	80.34	**<0.001**
S.Iron (ug/dl)	34.71	16.46	48.07	27.45	**<0.001**
S.Ferritin (ug/L)	13.88	23.23	103.22	208.18	**<0.001**
Vitamin B12(pg/ml)	452.03	259.02	464.64	159.44	0.230
Folic acid (ng/ml)	19.69	30.65	29.29	124.27	0.871

*Mann-Whitney test

With regards to the feeding practices, majority of the children with nutritional anemia did not have (>80%) exclusive breast feeding. There was no significant association between demographic and infant feeding practices of the children (Table 2) Prolonged breastfeeding has shown to have a negative impact on the anemia in children less than 5 years age [21]. However, neither the exclusive breast-feeding nor the timing of initiation of the complimentary feeding had a significant association with the nutritional anemia in the present study. In contrast, late weaning has been associated with increased risk of iron deficiency anemia among other causes, since this directly affects the iron stores of the baby [16,22]. Maternal diet has shown to impact the Vitamin B12 levels especially in the children less than 24 months of age [23].

Table 2: Association between the nutritional anemia and the probable etiological factors (N=250)

Factors	Nutritional Anemia				p value*
	Yes (69)		No (181)		
	Frequency	%	Frequency	%	
Sex					
Male	35	50.7	108	59.7	0.201
Female	34	49.3	73	40.3	
Age (months)					
12-24 months	18	26.1	33	18.2	0.544
12-36 months	16	23.2	52	28.7	
36-48 months	12	17.4	34	18.8	
48-60 months	23	33.3	63	34.3	
Exclusive breast feeding					
0-1 Month	5	7.2	13	7.2	0.793
1-4 Month	18	26.1	55	30.4	
4-6 Month	33	47.8	90	49.7	
6-12 Month	9	13	16	8.8	
>12 Month	4	5.8	6	3.3	
Introduction of complimentary feeding					
< 6 Months	3	4.3	8	4.4	0.155
6-10 Months	15	21.7	63	34.8	
10-12 Months	33	47.8	80	44.2	
>12 Months	18	26.1	30	16.6	
Introduction of artificial feeding					
0-1 Month	1	1.4	7	3.9	0.123
1-4 Month	24	34.8	57	31.5	
4-6 Month	12	17.4	53	29.3	
6-12 Month	29	42	62	34.3	
>12 Month	3	4.3	2	1.1	

*Chi-square test

Significantly higher proportion of children without nutritional anemia presented with lethargy (Table 3). In terms of the severity, significantly higher proportion of the children with nutritional anemia had moderate anemia (75.4%) while majority of the non-nutritional anemia cases were mild (50.8%). Nutritional anemia children had a significantly higher mircocytic hypochromic picture in the peripheral smear (55.1%), which can be attributed to the high Iron deficiency anemia in the children [24]. Although 9.6% of the children in the index study had Vitamin B12 or folic acid deficiency, megaloblastic picture or dimorphic presentation was not observed in the peripheral smear.

Table 3: Association between the nutritional anemia and manifestations in the study participants (N=250)

Manifestations	**Nutritional Anemia**				p value*
	Yes (69)		**No (181)**		
	Frequency	**%**	**Frequency**	**%**	
Presenting symptoms					
Pale Skin	50	72.5	110	60.8	0.085
Irritability	20	29	59	32.6	0.583
Lethargy	13	18.8	59	32.6	**0.032**
Easy Fatigue	14	20.3	51	28.2	0.204
Poor Appetite	17	24.6	60	33.1	0.193
Abnormal Rapid Breathing	1	1.4	9	5	0.204
Other Symptoms					
Pallor	69	100	181	100	-
Icterus	0	0	1	0.6	0.536
Lymphadenopathy	0	0	1	0.6	0.536
Edema	1	1.4	0	0	0.105
Clubbing	0	0	1	0.6	0.536
Cyanosis	1	1.4	0	0	0.105
Koilonychia	2	2.9	7	3.9	0.713
Glossitis	1	1.4	1	0.6	0.477
Chelitis	6	8.7	18	9.9	0.764
Cardiac murmur	3	4.3	0	0	**0.005**
Other factors					
PICA	14	20.3	35	19.3	0.865
Passage Of Worms	14	20.3	50	27.6	0.235
Behavioural Problems	12	17.4	47	26	0.153
Frequent Infections	5	7.2	6	3.3	0.175
H/O Major Illness	1	1.4	0	0	0.105
Severity of anemia					
Mild	14	20.3	92	50.8	**<0.001**
Moderate	52	75.4	81	44.8	
Severe	3	4.3	8	4.4	
Peripheral smear					
Normocytic and hypochromic	5	7.2	19	10.5	**0.003**
Microcytic and hypochromic	38	55.1	57	31.5	
Normocytic and normochromic	26	37.7	105	58	

*Chi-square test

In the present study, there was mild but significant correlation between the hemoglobin, RBC count, PCV, MCV, MCH and the serum ferritin. There was mild but significant correlation between the RBC count, MCH, MCHC and the serum Vitamin B12. There was mild but significant correlation between the RDW, MCHC and the serum folic acid. (Table 4)

Table 4: Correlation between the Hematological indices and the micro-nutrient levels

Hematological indices	Serum ferritin		Vitamin B12		Folic Acid	
	correlation	p value*	correlation	p value*	correlation	p value*
Hb	0.246	**<0.001**	-0.107	0.092	-0.070	0.272
RBCs	-0.149	**0.018**	0.238	**<0.001**	-0.049	0.444
PCV	0.204	**0.001**	0.019	0.767	-0.121	0.056
MCV	0.239	**<0.001**	-0.087	0.170	-0.095	0.133
MCH	0.179	**0.005**	-0.257	**<0.001**	-0.077	0.225
MCHC	0.120	0.057	-0.284	**<0.001**	0.148	**0.019**
RDW	-0.104	0.102	0.006	0.930	0.167	**0.008**
Reticulocyte count	-0.038	0.546	0.046	0.467	0.068	0.288

*Spearman correlation

Strengths & Limitations

The present study was undertaken with adequate power based on statistically calculated sample size. The hematological parameters were assessed in the accredited laboratories improving the validity. Data on the history and symptoms were collected by the single investigator, thus avoiding inter-rater bias. However, the index study is not devoid of limitations. The cross-sectional design of the study limits the confirmation of the association between the potential factors and the nutritional anemia. Selection bias may be present owing to inclusion of children who were hospitalized, rather than from the community, which limits the generalizability of the findings.

Conclusion

Overall, the proportion of nutritional anemia among children from one to five years is significant in Northern India. Prevalence of Iron deficiency anemia was 21.2% among the under five anemic children. Vitamin B12 and folate deficiency also contributes towards nutritional anemia. National health programs such as Anemia Mukt Bharat needs to be leveraged to address the nutritional causes of the anemia, as it is completely preventable as well as treatable. The severity of the anemia was also high among the children with nutritional anemia. Further, analytical studies to confirm the association of the clinical and hematological factors with nutritional anemia needs to be conducted in future. Community based studies, with dietary pattern need to be conducted to verify and improve the generalisability of our findings.

Conflicts of interest

The authors declares that they do not have conflict of interest.

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References

1. Safiri S, Kolahi A-A, Noori M, Nejadghaderi SA, Karamzad N, Bragazzi NL, et al. Burden of anemia and its underlying causes in 204 countries and territories, 1990–2019: results from the Global Burden of Disease Study 2019. J Hematol Oncol. 2021;14(1):185. https://doi.org/10.1186/s13045-021-01202-2
2. Keikhaei B, Zandian K, Ghasemi A, Tabibi R. Iron-deficiency anemia among children in southwest Iran. Food Nutr Bull. 2007 Dec;28(4):406–11.
3. Garder B. Anemias of Inadequate Production. In: Kliegman R, Behrman RE, Jensen HB, Stanton BF, editors. Nelson Textbook of Pediatrics. Philadelphia: W.B. Saunders; 2008. p. 2011–4.
4. Madoori S, C. R, Valugula S, G. S, Kotla S. Clinico hematological profile and outcome of anemia in children at tertiary care hospital, Karimnagar, Telangana, India. Int J Res Med Sci. 2015;3(12):3567–71. https://www.msjonline.org/index.php/ijrms/article/view/1959
5. World Health Orginazation. Anaemia.: https://www.who.int/health-topics/anaemia#tab=tab_1
6. World Health Orginazation. Anaemia in women and children. https://www.who.int/data/gho/data/themes/topics/anaemia_in_women_and_children
7. Jana A. Anaemia in women, children aggravated in 2019: NFHS-5. Available from: https://www.downtoearth.org.in/blog/health/anaemia-in-women-children-aggravated-in-2019-nfhs-5-74799
8. Kotecha P V. Nutritional anemia in young children with focus on Asia and India. Indian J community Med Off Publ Indian Assoc Prev Soc Med. 2011 Jan;36(1):8–16.
9. Ramawat D, Jain N. Clinicohematological Profile of Anemia in Children – A Retrospective Descriptive Study. Sch J Appl Med Sci. 2020 Oct 15;8:2266–70.
10. Cusick SE, Mei Z, Freedman DS, Looker AC, Ogden CL, Gunter E, et al. Unexplained decline in the prevalence of anemia among US children and women between 1988-1994 and 1999-2002. Am J Clin Nutr. 2008 Dec;88(6):1611–7.
11. Bathla S, Kannan E. Introduction BT - Agro and Food Processing Industry in India: Inter-sectoral Linkages, Employment, Productivity and Competitiveness. In: Bathla S, Kannan E, editors. Singapore: Springer Singapore; 2021. p. 1–14. https://doi.org/10.1007/978-981-15-9468-7_1
12. Chandra J, Dewan P, Kumar P, Mahajan A, Singh P, Dhingra B, et al. Diagnosis, Treatment and Prevention of Nutritional Anemia in Children: Recommendations of the Joint Committee of Pediatric Hematology-Oncology Chapter and Pediatric and Adolescent Nutrition Society of the Indian Academy of Pediatrics. Indian Pediatr. 2022;59(10):782–801.
13. Orsango AZ, Habtu W, Lejisa T, Loha E, Lindtjørn B, Engebretsen IMS. Iron deficiency anemia among children aged 2–5 years in southern Ethiopia: A community-based cross-sectional study. Peer J. 2021;9.
14. Levin C, Harpaz S, Muklashi I, Lumelsky N, Komisarchik I, Katzap I, et al. Iron deficiency and iron-deficiency anemia in toddlers ages 18 to 36 months: a prospective study. J Pediatr Hematol Oncol. 2016;38(3):205–9.
15. Natekar P, Deshmukh C, Limaye D, Ramanathan V, Pawar A. A micro review of a nutritional public health challenge: Iron deficiency anemia in India. Clin Epidemiol Glob Heal 2022;14:100992. https://www.sciencedirect.com/science/article/pii/S2213398422000331
16. Moscheo C, Licciardello M, Samperi P, La

Spina M, Di Cataldo A, Russo G. New Insights into Iron Deficiency Anemia in Children: A Practical Review. Metabolites 2022;12(4).

17. Chandra J, Jain V, Narayan S, Sharma S, Singh V, Kapoor AK, et al. Folate and cobalamin deficiency in megaloblastic anemia in children. Indian Pediatr. 2002 May;39(5):453–7.
18. Umasanker S, Bhakat R, Mehta S, Rathaur VK, Verma PK, Bhat NK, et al. Vitamin B12 deficiency in children from Northern India: Time to reconsider nutritional handicaps. J Fam Med Prim Care 2020;9(9):4985.
19. Song SM, Bae KW, Yoon H-S, Im HJ, Seo J-J. A case of anemia caused by combined vitamin B12 and iron deficiency manifesting as short stature and delayed puberty. Korean J Pediatr. 2010 May;53(5):661–5.
20. Kapil U, Sareen N. Prevalence of ferritin, folate and vitamin B12 deficiencies amongst children in 5-18 years of age in Delhi. Indian J Pediatr. 2014 Mar;81(3):312.
21. Khan JR, Awan N, Misu F. Determinants of anemia among 6–59 months aged children in Bangladesh: evidence from nationally representative data. BMC Pediatr 2016;16(1):3. https://doi.org/10.1186/s12887-015-0536-z
22. Mantadakis E, Chatzimichael E, Zikidou P. Iron Deficiency Anemia in Children Residing in High and Low-Income Countries: Risk Factors, Prevention, Diagnosis and Therapy. Mediterr J Hematol Infect Dis 2020;12(1).
23. Cetinkaya F, Yildirmak Y, Kutluk G, Erdem E. Nutritional vitamin B12 deficiency in hospitalized young children. Pediatr Hematol Oncol. 2007;24(1):15–21.
24. Chaudhry HS, Kasarla MR. Microcytic hypochromic anemia. Starpearls. 2017. https://www.ncbi.nlm.nih.gov/books/NBK470252/