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Research Article

Study of serum cobalamin level in vegetarian v/s nonvegetarian geriatric individuals

V. N. Mishra[1]*, Nalini Mishra[2], Rohit Khandelwal[1]

[1]Department of Medicine, Pt. J. N. M. Medical College, Raipur, (C.G.), India
[2]Department of Obstetrics and gynaecology, Pt. J. N. M. Medical College, Raipur, (C.G.), India

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***Correspondence:**
Dr. V. N. Mishra,
E-mail: drmishravn@gmail.com

ABSTRACT

Background: Vegetarianism is found in all geographic areas, they may have lower B-12 levels than nonvegetarian; problem could be graver in elderly. This study intended to recognise geriatric individuals with B-12 deficiency so as to save them from anaemia, dementia & neuropsychiatric disturbances by timely recommendations for supplementation.
Methods: Current study was conducted on 200 healthy attendants divided in to two groups- A comprised of 100 vegetarian and B of 100 nonvegetarian geriatric individuals (> 60yrs.), they had no previous chronic disease and an attempt was made to exclude diabetes mellitus, hypertension, chronic gastritis, hypoplastic & aplastic anaemia. Those with history of alcohol intake, PPI therapy & regular vitamin supplementation were excluded. Complete clinical examination and routine blood tests were done. Serum cobalamin level was determined by ACCU-BIND ELISA Microwells method.
Results: Total of 58 vegetarians were found to be B-12 deficient compared to 42 normal (>350pg/ml) this was statistically significant. Out of 100 nonvegetarian 48 were deficient while 52 had normal levels this too was statistically significant. On comparing the vegetarians and non vegetarian groups significant result was obtained ($p < 0.01$). When different age groups were statistically compared insignificant result was obtained, same was true for gender distribution. Statistically significant result was obtained on comparing vegetarian Vs nonvegetarian group.
Conclusions: Irrespective of the dietary habit B-12 deficiency is prevalent in elderly, as 58% of vegetarian & 48% of nonvegetarian were found B-12 deficient, detailed dietary analysis revealed that majority of them consumed nonvegetarian food only occasionally. No significant effect of increasing age & gender was found on B-12 levels in either group. Every elderly vegetarian or non vegetarian irrespective of gender should get their B-12 levels checked & if found low should receive B-12 supplement.

Keywords: Serum cobalamin level, Geriatric, Vegetarian, Nonvegetarian

INTRODUCTION

Cobalamin (vitamin B-12) exists in nature in number of different chemical forms. All have a cobalt atom at the centre of a corrin ring the form in human plasma is methyl cobalamin. It is the cofactor for methionine synthase. There is also minor amount of hydroxocobalamin to which methyl and ado cobalamins are converted by exposure to light. Cobalamin is synthesized solely by microorganisms. Ruminants obtain cobalamin from the foregut, but the only source for humans is food of animal origin e.g. meat, fish and dairy products. Vegetables, fruits, and other foods of non-animal origin are free from cobalamin unless contaminated by bacteria. A normal Western diet contains 5-30 microgram of cobalamin daily. Adult daily losses mainly in the urine and feces are 1-3 micrograms and as the body does not have the ability to degrade cobalamin, the daily requirements are also about 1-3 microgram. Body stores are of the order of 2-3 mg which is sufficient for 3-4 years if supplies are completely cut off.[1]

Vitamin B-12 functions as a methyl donor and works with folic acid in the synthesis of DNA of red blood cells and is vitally important in maintaining the health of the myelin sheath that surrounds nerve cells. A deficiency often manifests itself first in the development of neurological dysfunction that is almost indistinguishable from senile dementia and Alzheimer's disease. There is little question that many patients exhibiting symptoms of Alzheimer's actually suffer from a vitamin B12 deficiency. Their symptoms are totally reversible through effective supplementation. A low level of vitamin B12 has also been associated with asthma, depression, AIDS, multiple sclerosis, tinnitus, diabetic neuropathy and low sperm counts.

Vegetarian diets can be classified as lactovegetarian, ovovegetarian, lactoovovegetarian or vegan if they include, respectively dairy products, eggs, both dairy products and eggs or no animal products at all in their diet. Herrmann et al showed that vegans and to a lesser degree lactoovovegetarians and lactovegetarians have biochemical evidence of cobalamin deficiency.[2] Vegetarianism is present in all geographic areas, it is well known for many years that vegetarians have consistently lower vitamin B-12 concentrations than do non vegetarians. Dhopeshwarkar et al observed that asymptomatic Indian lactovegetarians who make up more than half of the Indian population had distinctly lower serum vitamin B12 concentrations than nonvegetarians.[3] This was confirmed by other studies from different geographic regions in India.[4] Because vegetarianism has been widely practiced for several millennia in India, much of the population of this country is at risk of having low levels throughout life. The superimposition of other conditions that perturb either vitamin B-12 absorption e.g. partial gastrectomy or bypass, proton pump inhibitors therapy, and ileal disease or surgical resection can easily dip such persons into frank vitamin B-12 deficiency much earlier than in non vegetarians who have better cobalamin stores.[5]

Elderly people are more vulnerable to suffer from vitamin B12 deficiency. As people age they become less and less able to absorb vitamin B12 from food not only this their production of the intrinsic factor needed to absorb the vitamin from the small intestine decline rapidly with age because of gastric atrophy and therefore are likely to develop deficiency.[6] This problem is still more apparent in elderly vegetarian population. The deficiency is usually only discovered when patients develop megaloblastic anaemia, however before this is reached, cobalamin deficient individuals may develop subtle symptoms of neuropsychiatric damage and signs of disorientation and confusion which are very difficult to recognize.[7] This study on serum cobalamin levels in vegetarian geriatric individuals intended to recognize those with this important vitamin deficiency so as save them in time from dementia & neuropsychiatric disturbance by timely recommendations for supplementation of vitamin B-12.

METHODS

The present prospective study was conducted in Pt. JNM Medical College & Dr. B.R.A.M. Hospital Raipur (C.G.), India, among healthy attendants of patients in medical OPD, wards and ICCU. They were divided in to two groups. Study group A comprised of 100 vegetarian geriatric individuals and Study group B comprised of 100 non vegetarian geriatric individuals, both the groups had no apparent established previous chronic disease. Among individuals fulfilling the inclusion criteria (>60 yrs) of age, an attempt was made to exclude Diabetes mellitus, Hypertension, Chronic gastritis, Hypoplastic & Aplastic anaemia. Those with history of chronic alcohol intake, on chronic PPI therapy & on regular vitamin supplementation were excluded from the study. All underwent complete clinical examination including general physical, systemic examination and detailed neurological examination. All the individuals also underwent complete blood count and peripheral smear for anaemia typing, liver function test, fasting blood sugar & urea estimation. Serum cobalamin level was determined by ELISA method using ACCU-BIND ELISA Microwells.[8] Data was compiled in MS excel and checked for its completeness, correctness and then it was analyzed. Suitable statistical test was applied and p value<0.05 was considered as a statistical significant.

RESULTS

Total of 41 out of 100 vegetarian geriatric individuals were found to be deficient in Serum Cobalamin (level < 200 pg/ml) Out of this 28 were in 60-69 yrs. age group, 10 in 70-79 yrs. age group and 3 were 80 yrs. and above. 17 out of 100 vegetarian geriatric individuals were found borderline deficient in Serum Cobalamin (level in

between 200 - 350 pg/ml) out of this 12 were in 60 – 69 yrs. age group and 5 in 70 – 79 yr age group. Rest of 42 vegetarian geriatric individuals had normal serum cobalamin level (> 350 pg/ml) When deficient and borderline deficiency groups were combined then total of 58 vegetarians were found to be B-12 deficient compared to 42 normal (>350 pg/ml) this was found to be statistically significant ($p < 0.05$), thus proving the hypothesis that majority of vegetarians are deficient in B-12. When different age groups were statistically compared and analyzed, insignificant results were obtained (Table 1).

Table 1: Analysis of levels of serum cobalamin in vegetarian geriatric individuals in different age groups.

Age group in yrs.	No of patients covered within a specified range of S cobalamin level & there mean B12 level with SEM				
	<200 pg/ml No. (%) Mean ± SEM	200-350 pg/ml No. (%) Mean ± SEM	>350 pg/ml No. (%) Mean ± SEM	Total Mean ± SEM	Chi square & P value
60-69 yrs. n=69	28 (40.5) 145.45±8.31	12 (17.3) 264.83±14.02	29 (42) 668.97±52.08	69 386.24±36.93	$X^2 = 7.91$ p = 0.01
70-79 yrs. n=25	10 (40) 127.24±16.48	5 (20) 227.34±8.43	10 (40) 687.58±68.50	25 371.39±59.83	$X^2 = 2$ p = 0.36
80 yrs. & above n=6	3 (50) 120.03±28.01	0	3 (50) 452.33±66.21	6 286.18±81.64	$X^2 = 3$ p = 0.22
Total	41 (41) 139.14±7.34	17 (17) 253.80±18.34	42 (42) 657.93±40.25	100 376.53±29.82	$X^2 = 12.02$ p = 0.002

Out of 100 non vegetarian geriatric individuals, 22 were found to be deficient in Serum cobalamin (level < 200pg/ml.) 18 were in 60-69 yrs. age group, only 1 in 70-79 yrs. group and 3 were 80 yrs. and above. 26 individuals were found to be borderline deficient in Serum Cobalamin (level in between 200 to 350 pg /ml). Out of this 18 were in 60 -69 yrs. age group, 6 in 70-79 yrs. age group and 2 in 80 yrs. and above. Rest of 52 had normal serum cobalamin level (more than350 pg/ml). When deficient and border line deficiency groups were combined then total of 48 non vegetarians were B-12 deficient compared to 52 normal (>350 pg/ml), this was found to be statically significant proving the fact that the majority of geriatric non vegetarians too were B-12 deficient. When different age groups were statistically compared insignificant result was obtained (Table no 2). On statistically analyzing vegetarians and non vegetarian groups significant result was obtained ($p < 0.01$) proving the hypothesis that vegetarians are more B-12 deficient as compared to non vegetarians. In this study in vegetarian group number of males and females who were found to be deficient in serum cobalamin (level less than 200 pg/ml) were 40% and 41% respectively where as in non vegetarian group 22% males and 21% females were B-12 deficient. When cut off value was raised to 350 pg/ml, 61% males and 54% females were B-12 deficient in vegetarian group while in non vegetarian group 49% males and 45% females were found to be B-12 deficient, statistical analysis of these findings revealed insignificant outcome ($p > 0.05$) thus proving that there is no effect of gender on serum cobalamin level in either group (Table no 3 & 4).

In vegetarian group out of total 17 pure vegan individuals, B-12 deficiency was observed in 12 (70.5%) when 200pg/ml was taken as cut off value. Considering 200-350 pg/ml as borderline deficient range, 2 more patients were added in this group. Out of total 83 lacto vegetarians, 29 (35%) were found to be B-12 deficient at cut off value 200 pg/ml and at borderline deficient range (200-350 pg/ml) 15 more patients were added in this group. When both subgroups were statistically analyzed with nonvegetarian group significant result ($p<0.05$) was obtained thus proving that pure vegans and lacto vegetarians are in general more B-12 deficient than nonvegetarian. When the two subgroups were statistically compared with each other then also statistically significant result($p < 0.02$) was obtained proving the hypothesis that pure vegans are more B-12 deficient than lacto vegetarians.

DISCUSSION

Studies have found that Vitamin B12 deficiency is a potential concern for anyone with insufficient dietary intake of vitamin B12, including those adhering to a vegetarian diet. This is still more important in Geriatric individuals as mentioned earlier. The mean B-12 level in our total study population (both vegetarian and non vegetarian groups) was found to be 415.11pg/ml. The mean B-12 level in our vegetarian group was observed to

be 376.5pg/ml which itself is in a lower normal range, while non vegetarian group had 453.6 pg/ml as its mean B-12 level. Over the years various study groups have proposed higher B-12 values as cut off for the deficiency state. In Japan, the lowest acceptable level for vitamin B-12 in blood has been raised from200 pg/ml to 550pg/ml (Mitsuyama Y et al). Lindenbaum et al observed that many individuals presented with deficiency symptoms at serum vitamin B-12 levels as high as 350pg/ml where as another group Tiggelen et al recommended normal levels to be 600pg/ml.[9] So if we consider above mentioned cut off values as our deficient range, almost entire study population of ours including vegetarians and non vegetarians will be labeled as cobalamin deficient as our mean B12 level of total study population was 415.11 pg/ml only.

Table 2: Analysis of serum cobalamin levels in non-vegetarian geriatric individuals in different age groups.

Age group in yrs.	No of patients covered within a specified range of S Cobalamin level & there mean B12 level with SEM				
	<200 pg/ml No. (%) Mean ± SEM	200-350 pg/ml No. (%) Mean ± SEM	>350 pg/ml No. (%) Mean ± SEM	Total Mean ± SEM	Chi square & P value
60-69 yrs. n=77	18 (23.3) 156.35±8.53	18 (23.3) 276.05±10.50	41 (53.2) 659.94±40.04	77 452.48±33.55	X^2 = 13.74 p = 0.001
70-79 yrs. n=13	1 (7.6) 98.61±0	6 (46.2) 255.18±20.57	6 (46.2) 879.13±132.8	13 531.11±110.7	X^2 = 3.84 p = 0.14
80 yrs. & above n=10	3 (30) 148.46±20.7	2 (20) 245.35±1.64	5 (50) 537.58±50.14	10 362.40±64.20	X^2 = 1.4 p = 0.49
Total	22 (22) 152.65±7.79	26 (26) 268.87±8.74	52 (52) 673.47±36.65	100 453.69±30.20	X^2 = 15.92 p = 0.00

Table 3: Analysis of the effect of gender on serum cobalamin level in vegetarian geriatric individuals.

Gender	No of patients covered within a specified range of S Cobalamin level and there mean B12 level with SEM				
	<200 pg/ml No. (%) Mean ± SEM	200-350 pg/ml No. (%) Mean ± SEM	>350 pg/ml No. (%) Mean ± SEM	Total No. Mean ± SEM	Chi square & P value
Male	19(40) 131.83±12.00	10(21) 251.43±17.15	18(38) 656.80±73.86	47 358.33±45.29	X^2=3.10 p = 0.21
Female	22(41) 145.46±8.96	7(13) 257.20±14.29	24(45) 658.77±45.06	53 392.66±39.67	X^2=9.77 p = 0.007
Total	41(41) 139.14±7.34	17(17) 253.80±10.90	42(42) 657.93±40.25	100 376.53±29.82	X^2=1.25 p = 0.53

In our study when level < 200 pg/ml was taken as cut off level for B12 deficiency, 31.5 % individuals of total study population were found to be deficient. But when cut off level was raised to 350 pg/ml 53% of the total study population was found to be B12 deficient. Similar study by Sarika Arora et al on urban North Indian population (n=422) depicted that 43% of the total subjects (182 out of 422) had vitamin B-12 deficiency (levels <200pg/ml) but when cut off value was raised to 350 pg/ml, 77.7% population was found to be B-12 deficient.[10] Another study from Gujarat by Saritaben et al took 211pg/ml as cut off for deficiency state and found 38% subjects to be B-12 deficient. But at level less than 350 pg/ml 70 % were found to be deficient. The probable reason for this high prevalence in both the above studies as compared to our study could be the difference in staple diet of various regions; our study was conducted among the population whose staple diet includes fermented rice which in itself is a good source of microorganisms and hence B-12.

It is evident from our study that irrespective of the dietary habit, vitamin B-12 deficiency is prevalent in elderly individuals in our society, similar observations have been made by workers from other countries as well as 58% of vegetarian geriatric individuals were found to be B-12

deficient while 48% of non vegetarian elderly individuals were also deficient (cut off level 350 pg/ml).[11,12] Detailed dietary analysis of this nonvegetarian group found that majority of them consumed non vegetarian food only occasionally. Vitamin B-12 deficiency among non vegetarian individuals has been reported from studies outside India also. A study from Sydney Australia by Hokin et al reported B-12 deficiency in 40 % of non vegetarians which is close to our observation as 48% of our non vegetarians were found to be B12 deficient.[13]

Table 4: Analysis of the effect of gender on serum cobalamin level in non-vegetarian geriatric individuals.

Gender	No of patients covered within a specified range of S Cobalamin level and there mean B12 level with SEM				
	<200 pg/ml No. (%) Mean ± SEM	200-350 pg/ml No. (%) Mean ± SEM	>350 pg/ml No. (%) Mean ± SEM	Total No. Mean ± SEM	Chi square & P value
Male	14(22) 142.73±11.01	17(27) 273.53±11.15	31(50) 652.99±34.50	62 431.54±33.82	X^2=4.96 p = 0.08
Female	08(21) 170.00±6.29	09(24) 260.06±14.31	21(55) 703.70±75.96	38 486.27±57.78	X^2=3.26 p = 0.07
Total	22(22) 152.65±7.79	26(26) 268.87±8.74	52(52) 675.55±36.95	100 453.69±30.20	X^2=0.27 p = 0.87

Gilsing et al in a cross sectional analysis involving 689 men (226 omnivores, 231 vegetarians & 232 vegans) found that mean serum vitamin B-12 was highest among omnivo-res (281 pmol/l), intermediate among vegetarians (182 pmol/l) and lowest among vegans (122 pmol/l).[14] In all 52% of vegans, 7% of vegetarians and one omnivore were classified as vitamin B-12 deficient (deficiency state defined as serum vitamin B12 <118 pmol/l). The cut off level of serum cobalamin was too low in this study as compared to our study (200 pg/ml) probably explaining the difference in results. T. Kwok et al in a study on 119 women older than 55 years who had been vegetarian for more than 3 years found the prevalence of definite vitamin B-12 deficiency to be 42%, which is similar to our result. Study by Wolfgang Herrmann et al also found that the vegans had the lowest vitamin B-12 status. Hokin et al in their study on lactoovovegetarians and vegans found that 73% of them were B-12 deficient compared to the nonvegetarian group in which only 40% were found to be deficient. The European Prospective Investigation into Cancer and Nutrition (EPIC) Oxford cohort study also found similar results (Gilsing et al). Our findings are in concordance with most of the studied cited above explaining that B-12 deficiency is most prevalent in pure vegan group, followed by lactovegetarian and non vegetarian group.

No statistically significant effect of gender distribution was found on B-12 level in either group in our study. In a hospital based study by Sarika Arora et al from Delhi concluded that risk of developing B-12 deficiency is affected by gender. They observed B-12 deficiency in 19.4% men and 23.7% women. While Saritaben et al from Gujarat found that gender did not appear to contribute towards the B-12 deficiency which is similar to our observation. Similar observations were made in a study by Gupta et al in adult South Asian patients at a Toronto clinic, so present study is consistent with most of the other studies suggesting that serum cobalamin level is not affected by gender.

CONCLUSION

Vitamin B12 deficiency is a potential concern for anyone with insufficient dietary intake of vitamin B-12, those adhering to a vegan or vegetarian diet or significantly restricting animal based foods are at a high risk of developing its deficiency. Elderly vegetarians, particularly vegans were found to have very low serum vitamin B-12 levels. It is evident in various studies that neurological manifestations might present at much higher B12 level than expected which in itself explains the importance of this vitamin. So all elderly vegans, and lactoovovegetarians who do not consume adequate amounts of dairy products or eggs to provide sufficient vitamin B-12 are vulnerable for B-12 deficiency. One other important finding which is evident from this study is that B-12 deficiency is also a concern in elderly non vegetarians. No effect of gender distribution was found on B-12 level in either group in our study. It is therefore suggested that every elderly patient either vegetarian or non vegetarian irrespective of gender should therefore get their B-12 levels checked and supplement their diet with vitamin B-12 from fortified foods or supplements.

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REFERENCES

1. Hoffbrand AV. Megaloblastic Anemias; Harrissons Principle of Internal Medicine. 18th edition, Longo, Fauci, Kasper, Hauser, et al. (eds), Mc Graw Hill. 2012:862-71.
2. Herrmann W, Schorr H, Obeid R, et al. Vitamin B-12 status, particularly holo-transcobalamin II and methylmalonic acid concentrations, and hyperhomo-cysteinemia in vegetarians. Am J Clin Nutr. 2003;78:131-6.
3. Dhopeshwarkar GA, Trivedi JC, Kulkarni BS, et al. The effect of vegetarianism and antibiotics upon proteins and vitamin B12 in the blood. Br J Nutr. 1956;10:105–10.
4. Antony AC. Megaloblastic anemia. Hematology Basic principles and practice. Hoffman R, Benz EJ Jr, Shattil SJ, et al. 3rd ed. New York: Churchill-Livingstone. 2000:446-85.
5. Mehta BM, Rege DV, Satoskar RS. Serum vitamin B12 and folic acid activity In lactovegetarian and non-vegetarian healthy adult Indians. Am J Clin Nutr. 1964;15:77-84.
6. Nielsen MJ, Rasmussen MR, Andersen CB et al. Vitamin B -12 transport from food to the body's cells a sophisticated, multistep pathway. Nat Rev Gastroenterol Hepatol. 2012;9:345-54. Br J Nutr. 1956;10:105-10.
7. Dharmarajan TS, Adiga GU, Norkus EP. Vitamin B12 deficiency. Recognizing subtle symptoms in older adults. Geriatrics. 2003;58:37-8.
8. Burtis CA, Ashwood RA. Tietz Referance information for the clinical laboratory. In textbook of clinical chemistry 3rd edition, W.B. Saunders: Philadelphia. 1999:383-7.
9. Lindenbaum J, Healton EB, Savage DG, et al. Neuropsychiatric disorders caused by cobalamin deficiency in the absence of anemia or macrocytosis. N Engl J Med. 1988;318:1720-8.
10. Arora S, Singh B, Gupta VK, et al. Burden of vit B-12 deficiency in urban population in Delhi, India: A hospital based study. India International Journal of Pharma and Bio Sciences. 2011;2(1):521-28.
11. Dali-Youcef N, Andrés E, An update on cobalamin deficiency in adults. QJM. 2009;102(1):17-28
12. Stover PJ. Vitamin B12 and older adults. Curr Opin Clin Nutr Metab Care. 2010;13:24-7.
13. Bevan DH, Terry B. Cyanocobalamin (vitamin B-12) status in Seventh-day Adventist ministers in Australia. American Journal of Clinical Nutrition. 1999;70:576S-8S.
14. Gilsing AM, Crowe FL, Lloyd-Wright Z, et al. Serum concentrations of vitamin B12 and folate in British male omnivores, vegetarians and vegans: results from a cross-sectional analysis of the EPIC-Oxford cohort study. Eur J Clin Nutr. 2010;64:933-9.

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