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Prevalence of vitamin D3 and vitamin B12 in obese women and their correlation with BMI severity

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Abstract

The prevalence of vitamin D3 and vitamin B12 deficiencies in 33 obese women between the ages of 16 and 41 was investigated in this study, along with their correlation with the body mass index (BMI)-based measure of obesity severity. According to the distribution of obesity levels, the majority of participants had increased body mass but had not yet attained the severe stages of obesity, with 42.4% being classified as obese class I, 6.1% as obese class II, 12.1% as obese class III, and 39.4% as overweight. The results of the vitamin D3 analysis showed that 48.49% of the women had inadequate levels, 3.03% had inadequate levels, and 48.48% had adequate levels. Because vitamin D3 is fat-soluble and becomes trapped in adipose tissue, lowering its availability in circulation, it may be the cause of vitamin D3 deficiency in obese women. This deficiency is further exacerbated by low dietary intake of foods high in vitamin D and limited exposure to sunlight. On the other hand, the results for vitamin B12 showed that 72.72% of participants had deficiencies, 18.18% had borderline levels, and only 9.1% had sufficient levels. These results could be explained by reduced absorption brought on by gastrointestinal changes, insufficient consumption of foods high in B12 (such as meat, fish, eggs, and dairy), and unbalanced diets. Furthermore, among the same group, vitamin B12 levels were found to be significantly lower than vitamin D3 levels; this is probably because of variations in solubility, absorption mechanisms, and dietary sources. The study's overall findings emphasise the high prevalence of vitamin deficiencies, especially those related to vitamin B12, among obese women, underscoring the necessity of nutritional monitoring and preventive dietary interventions in this population.

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1. Introduction

Obesity has emerged as one of the most significant global public health issues, through a high prevalence among women. It is characterised by an excessive buildup of body fat, which is usually measured using the body mass index (BMI) ^[1]. Obese people are often reported to have nutritional deficiencies, particularly those involving water-soluble and fat-soluble vitamins ^[2]. Obesity is becoming more common around the world, and the World Health Organisation (WHO) has called it a global epidemic. A complicated, diverse, chronic, and progressive illness, obesity has a major impact on mortality, quality of life, and overall health. Although lifestyle and behavioral interventions are crucial for managing obesity, only a small percentage of people experience a significant and long-lasting response when they are used alone. Preventive measures at the population level have not been enough to slow down this trend. Bariatric (metabolic) surgery is still the best and longest-lasting treatment. It has been shown to help with more than just weight loss, such as heart and kidney health, lower rates of obesity-related cancers and deaths, and more. There has been a lot of progress in making drugs that can help people lose weight almost as well as metabolic surgery.

More and more outcome data are coming in about these drugs' use. But all of the ways to treat obesity have been used far too little [3]. Two significant public health issues are vitamin D deficiency and obesity. Evidence points to a potential risk factor for obesity: changes in the composition of the gut microbiota [4]. Compared to men, adult women are more likely to be obese. Furthermore, there is proof that obesity increases the risk of developing metabolic and endocrinologic disorders such as increased insulin resistance (IR) and hypovitaminosis D (VITD) [5]. Obesity in women represents one of the most important global health challenges, as it is associated with a higher risk of heart disease, diabetes, and metabolic complications. Cobalamin, also known as vitamin B12, is a necessary vitamin for DNA synthesis, the metabolism of proteins and fatty acids, and other metabolic processes that are essential to the health of human cells and tissues [6]. DNA stability is significantly influenced by vitamin B12. Vitamin B12 supplementation may counteract the indirect DNA damage caused by vitamin B12 deficiency, according to research. Enzymes involved in DNA methylation and nucleotide synthesis, including methionine synthase and methylmalonyl-CoA mutase, require vitamin B12 as a cofactor [7], obtained solely through diet. Meat (especially red meat and poultry) and foods derived from animals (such as milk, cheese, and eggs) are its main sources. Additionally, seafood like crab and shellfish contain it [8,9]. The presence of intestinal bacteria in the proper section of the intestine determines the availability of vitamin B12 that they produce; the small intestine is where vitamin B12 is absorbed; the proportion of bacteria that produce cobalamin to those that consume it; and the existence of bacterially-driven illnesses [10,11]. The quantity and quality of protein ingested affects its availability and absorption. Up to 45% less vitamin B12 can be found in food preparation,

particularly when meat and milk are heated [12]. More than 10 µg of vitamin B12 per 100 g is found in the liver and kidney, but absorption declines when a meal contains more than 2 µg [13]. Meat has higher levels of vitamin B12 than milk and dairy products. 1.6–4.3 µg/d of vitamin B12 is found in one serving of milk, 60 g of hard cheese, or 150 g of yoghurt [14]. In contrast, a deficiency of vitamin B12 –an essential micronutrient – may contribute not only to known problems such as anemia and neurological disorders, but also to metabolic dysfunction that may support or worsen obesity 6. Dietary cobalamin has a bioavailability of 1.5–2 µg per meal. It is absorbed by intestinal microvilli via particular receptors in the small intestine's terminal tract after arriving bound to the intrinsic factor (IF) [15].

2. Materials and Methods

This study investigated the prevalence of vitamin D3 and vitamin B12 deficiencies in 33 obese women between the ages of 16 and 41, along with their correlation with the body mass index (BMI)-based measure of obesity severity. Participants in the study were adult women who visited outpatient clinics at specific medical facilities in Mosul, Iraq. Blood samples were taken to measure the level of serum vitamin D3 and B12.

3. Results

Vitamins D3 and B12 were measured in 33 blood samples from obese women between the ages of 16 and 41. Obesity levels were distributed as follows, according to the body mass distribution of obesity: 42.4% were obese class I, 6.1% were obese class II, 12.1% were obese class III, and 39.4% were overweight, this indicates that although the majority of participants have a discernible increase in body mass, they have not yet attained the severe stages of obesity (Table 1).

Table 1: Distribution of samples by body mass index (BMI)

Number of Participants (n)	Total	Age (years)	Weight (kg)	BMI Category (kg/m ²)
1	13 (39.4%)	16	85-95	Overweight
1		20		
1		27		
3		28		
1		30		
1		32		
2		36		
2		37		
1		41		
1		16	96-105	Obese Class I
2	14 (42.4%)	20		
1		21		
1		24		
2		26		
2		30		
1		33		
2		34		
1		37		
1		40		
1	2 (6.1%)	28	111	Obese Class II
1		29		
1	4 (12.1%)	37	117-119	Obese Class III
1		16		
1		19		
1		30		

The D3 levels test results also revealed that 48.49% had deficiencies, 3.03% had insufficient levels, and 48.48% had

sufficient level (Table 2). Since vitamin D3 is fat-soluble, adipose tissue stores it. Due to the excessive buildup of fat in

obese individuals, a significant amount of vitamin D3 is trapped inside fat cells, resulting in a decrease in blood concentration of the vitamin (i.e., an apparent deficiency upon analysis). Obese women are also more likely to experience deficiencies because they are frequently exposed to sunlight for shorter periods of time or consume diets low in dairy and fish. Because of inadequate sun exposure and vitamin retention in fat, vitamin D3 deficiency is prevalent in obese women. According to the results of the B12 levels test, 9.1% had sufficient levels, 18.18% had borderline levels, and 72.72% had deficiencies (Table 3). A chemical known as endogenous factor (Intrinsic Factor), which is eliminated

from the stomach, aids in the absorption of vitamin B12 in the small intestine. Infections or changes in the digestive system can interfere with the absorption of vitamins in obese women. Insufficient consumption of foods high in B12, such as liver, fish, eggs, and red meat; or an unbalanced or low-calorie diet deficient in this vitamin. Table 4 demonstrates that the sample of obese women had significantly lower vitamin B12 levels than vitamin D3 levels in the same group. Differences in the two vitamins' fat solubility, dietary sources, and absorption processes may account for the noticeably lower levels of vitamin B12 in obese women when compared to vitamin D3.

Table 2: Age and Vitamin D3 Status in Obese Women: A Correlation

Sample No.	Age (Years)	D3 (ng/mL)	Total (%)	D3 Status
1	16	8.1>	16 (48.49%)	Deficient
2	20	8.5		Deficient
3	28	12.3		Deficient
4	29	11.7		Deficient
5	34	9.0		Deficient
6	37	11.57		Deficient
7	28	10.6		Deficient
8	36	14.62		Deficient
9	24	16.2		Deficient
10	16	8.1>		Deficient
11	19	8.9		Deficient
12	21	8.1>		Deficient
13	16	15.7		Deficient
14	30	8.1>		Deficient
15	29	9.9		Deficient
16	26	14.5		Deficient
17	33	20.0	1 (3.03%)	Insufficient
18	37	36.1	16 (48.48%)	Sufficient
19	26	48.8		Sufficient
20	32	85.5		Sufficient
21	37	32.7		Sufficient
22	34	42.1		Sufficient
23	30	43.9		Sufficient
24	30	44.8		Sufficient
25	16	58.6		Sufficient
26	40	43.2		Sufficient
27	37	57.4		Sufficient
28	27	31.8		Sufficient
29	20	58.7		Sufficient
30	28	43.8		Sufficient
31	41	53.2		Sufficient
32	37	30.1		Sufficient
33	30	44		Sufficient

Table 3: Age and Vitamin B12 Status in Obese Women: A Correlation

Sample No.	Age (Years)	B12 (pg/mL)	Total (%)	B12 Status
1	33	174.60	24 (72.72%)	Deficient
2	40	177.60		Deficient
3	36	174.88		Deficient
4	27	179.20		Deficient
5	20	150.31		Deficient
6	16	179.46		Deficient
7	19	176.05		Deficient
8	21	187.16		Deficient
9	30	181.40		Deficient
10	29	170.70		Deficient
11	28	185.34		Deficient
12	41	178.23		Deficient
13	30	174.62		Deficient
14	28	185.34		Deficient
15	32	181.90		Deficient

16	28	194.36		Deficient
17	26	192.92		Deficient
18	34	195.66		Deficient
19	37	184.94		Deficient
20	37	193.87		Deficient
21	30	6.42		Severe Deficiency
22	36	166.77		Deficient
23	16	190.36		Deficient
24	16	179.50		Deficient
25	24	273.44	6 (18.18%)	Borderline
26	26	203.17		Borderline
27	20	233.34		Borderline
28	29	209.98		Borderline
29	34	225.11		Borderline
30	30	210.82		Borderline
31	37	318.53	3 (9.1%)	Sufficient
32	28	431.20		Sufficient
33	37	343.81		Sufficient

Table 4: Comparison Table: Vitamin D3 and Vitamin B12 Levels

Vitamins	Deficient %	Sufficient %	Borderline %
D3	48.49%	48.48%	3.03%
B12	72.72%	9.1%	18.18%

4. Discussion

Although research on obesity is progressing quickly, the prevalence of obesity is rising more quickly. Researchers have discovered over the last thirty years that biopsychosocial factors influence weight gain far more than individual decisions and accountability [16]. In the current investigation, 33 obese women between the ages of 16 and 41 had their serum levels of vitamins D3 and B12 assessed. 42.4% of participants were categorised as obese class I, 6.1% as class II, 12.1% as class III, and 39.4% as overweight, according to the obesity distribution. According to this distribution, most participants did not yet fall into the severe obesity categories, even though the majority showed an increase in body mass. This offers a great chance to see nutritional changes early in the development of obesity.

In terms of vitamin D3 status, 48.49% of participants had deficiencies, 3.03% had inadequate levels, and 48.48% had adequate concentrations. These results demonstrate that vitamin D3 deficiency affected nearly half of the obese women. Being a fat-soluble vitamin, vitamin D3 has a tendency to build up in adipose tissue, which can result in sequestration and decreased circulation bioavailability. As a result, even when total body stores are sufficient, obese people may exhibit low serum D3 concentrations. The deficiency is also exacerbated by lifestyle factors that are common among obese women, such as a lack of outdoor physical activity, less sun exposure, and a low consumption of foods high in vitamin D, such as fish and dairy products. Therefore, lowering vitamin D3 levels in this group is a result of a combination of biological and behavioural factors.

Only 9.1% of the women had adequate levels of vitamin B12, 18.18% had borderline concentrations, and a startling 72.72% were deficient, according to the results. Given that obese people frequently eat diets high in energy but low in nutrients, which lack sufficient animal-based sources of vitamin B12, this high prevalence of B12 deficiency is alarming and may be related to dietary patterns. Furthermore, B12 deficiency may be made worse by gastrointestinal changes linked to obesity, such as decreased absorption efficiency or modifications in intrinsic factor production. People of all ages can suffer from a B12 deficiency, and dietary consumption of

foods derived from animals that contain B12 is limited [17]. In this study, the vitamin B12 deficiency was more severe than the vitamin D3 deficiency, suggesting that the dietary and physiological changes associated with obesity may have a greater impact on vitamin B12 metabolism. This finding is consistent with earlier research showing a negative correlation between body mass index (BMI) and serum B12 levels.

There are a number of physiological and nutritional reasons why vitamin B12 levels were found to be significantly lower than vitamin D3 levels in obese women. Vitamin B12 is totally dependent on dietary intake and effective gastrointestinal absorption, in contrast to vitamin D3, which can be produced in the skin by exposure to sunlight. Obesity is commonly linked to altered gastric function and chronic low-grade inflammation, which may decrease the ileum's production of intrinsic factor, which is necessary for B12 absorption. Furthermore, obese people frequently have unbalanced diets that are high in calories but low in nutrients, which results in inadequate intake of foods high in B12, such as dairy, fish, and meat. Further, the changes in mucosal integrity and gut microbiota brought on by obesity may make it more difficult for the body to absorb vitamin B12. Decreased B12 levels may also result from the frequent use of drugs like metformin or proton pump inhibitors, which are common in obese people. On the other hand, vitamin D3 levels, while frequently below optimal, may be comparatively higher as a result of partial compensation from supplementation or exposure to sunlight. As a result, the more severe vitamin B12 deficiency than vitamin D3 deficiency is a result of the combined effects of gastrointestinal problems, medication-related interference, and inadequate diet—all of which are frequent side effects of obesity.

5. Conclusion

According to the current study, vitamin deficiencies are highly prevalent in obese women between the ages of 16 and 41. Despite the fact that most participants fell into the overweight and class I obesity categories, there were clear deficiencies in both vitamin D3 and vitamin B12. Due to the sequestration of this fat-soluble vitamin within adipose

tissue, as well as in-adequate dietary intake and limited exposure to sunlight, nearly half of the participants had insufficient or deficient vitamin D3 levels. More than 70% of the women in the study had a particularly severe vitamin B12 deficiency, indicating that obesity may affect the way this vital micronutrient is absorbed through the diet. These results highlight the necessity of targeted interventions, including dietary counselling, vitamin supplementation, and lifestyle modification, to prevent long-term metabolic and neurological complications linked to these deficiencies. They also emphasise the significance of routine nutritional screening for obese women.

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