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EFFECTS OF VITAMIN D DEFICIENCY ON MENTAL HEALTH: A COMPARATIVE STUDY ON YOUNG ADULTS AND MIDDLE-AGED FEMALES

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Abstract

Background: The present research study concentrates on the slowly and silently increasing epidemic – vitamin D deficiency and its psychological consequences on women. The ever-evolving lifestyle of multi facilitated cities is making us distant from exposure of sunlight and other physiological causes leading to this deficiency. Kolkata based women are assessed on the basis of their different categories of vitamin D deficiency and its effect on their mental health. **Methodology:** The sample of the study includes two groups of women (young adults and middle age), they were further sub-divided into three categories. The statistical measure includes t test and correlation. **Results:** The results show that in case of young adults there are significant differences between normal individuals and their other two counterparts in terms of wellbeing. Young adults who consume supplements have lower depression. In case of middle age women there is a significant difference in terms of depression. And, there are significant effects of Depression and Anxiety caused due to vitamin D deficiency on the mental health and wellbeing of both the groups. **Conclusion:** Vitamin D deficiency is one of the crucial factors in causing depression and anxiety, which negatively effects the wellbeing of women of all the ages. Supplements are essential because consumption of these can cure the deficiency which will automatically promotes positivity, prevents against spreading viruses, improves physiological health and good mental health.

Keywords*: vitamin D deficiency, depression, anxiety, wellbeing, women.*

Introduction:

Vitamin D or the sunshine vitamin is a group of fat-soluble secosteroids responsible for increasing intestinal absorption of calcium, magnesium and phosphate, and multiple other biological effects. In humans, the most important compounds in this group are vitamin D3 (Cholecalciferol) and vitamin D2 (Ergocalciferol). The major natural source of vitamin D is synthesis of Cholecalciferol in the skin from cholesterol through a chemical reaction that is dependent on sun exposure.

Several forms of vitamin D exist, depending on the variations of chemical composition they possess.

NAME	CHEMICAL COMPOSITION
VITAMIN D1	Mixture of molecular compounds of ergocalciferol with lumisterol, 1:1.
VITAMIN D2	Ergocalciferol (made from ergosterol)
VITAMIN D3	Cholecalciferol (made from 7 – dehydrocholesterol in the skin)
VITAMIN D4	22 - Dihydroergocalciferol
VITAMIN D5	Sitocalciferol (made from 7 – dehydrositosterol)

Chemically, the various forms of vitamin D are secosteroids, I.e.; steroids in which one of the bonds in the steroid rings is broken. The structural difference between vitamin D2 and D3 is the side chain of D2 contains a double bond between carbons 22 and 23, and a methyl group on carbon 24.

Vitamin D is a vital component for survival and its presence in our body has a number of health benefits.

Firstly, it is required for healthy bones. Vitamin D plays a substantial role in the regulation of calcium and maintenance of phosphorous levels in the blood, two factors that are extremely important for maintaining healthy bones.

Secondly, the Vitamin D helps in reducing risk of influenza A infection.

Thirdly, several observational studies reveal that there is an inversely proportionate relationship between blood concentration of vitamin D in the body and risk of type 2 diabetes. In people with type 2 diabetes, insufficient vitamin D may negatively effects insulin secretion and glucose tolerance.

Fourthly, vitamin D promotes healthy infants. Studies have associated low vitamin D with a higher risk of atopic childhood diseases and allergic diseases, including asthma, atopic dermatitis and eczema.

Fifthly, vitamin D helps in healthy pregnancy. Pregnant women who are deficient in vitamin D seem to be at a greater risk of developing preeclampsia and needing a cesarean section.

Lastly, vitamin D prevents cancer. (Ware, 2017)

Vitamin D has multiple roles in the body, it helps in maintaining the health of bones and teeth, support the health of the immune system, brain and nervous system. Regulate insulin levels and aid diabetes management, also support lung function and cardiovascular health. It also influences the expression of genes involved in cancer development. (Ware, 2017)
The benefits of having high vitamin D is immense and its absence can result to severe health issues even resulting into death.

The major natural source of vitamin D is synthesis of cholecalciferol in the skin from cholesterol through a chemical reaction that is dependent on sun exposure and some dietary supplements, which must be included in our daily diet.

Vitamin D3 can be found in small amounts in food, either fatty fish or fortified foods. Vitamin D2 can be found in irritated mushrooms and fortified foods.

Vitamin D after entering the body goes through a number of processes and turned into different forms, to be effective.

Vitamin D3 is made in our skin. When our skin gets exposed to Ultraviolet B rays of the sun, "photolysis" happens of a chemical called 7 – dehydrocholesterol, resulting into previtamin D3. This process takes place on the outermost layer of our skin – the epidermis. This previtamin D3 is "rearranged" into vitamin D3 and then "ejected" into what is called "extracellular fluid space". From here, vitamin D3 binds to a protein that is able to ship vitamin D and vitamin D related things all over our body. After vitamin D3 is constructed in the skin, this binding protein ships into the liver. (Vitamin D Council, 2019)

And, when vitamin D is taken as a food or supplement, is absorbed in our intestine and from here it is collected by that binding protein and taken to the liver (Vitamin D Council, 2019)
In this liver, vitamin D is turned into a chemical called Calcidiol. The process it goes through is called "hydroxylation". After hydroxylation in the liver into 25 – hydroxyvitamin D (25(OH)D) and kidney into 1, 25 – dihydroxyvitamin D (1,25(OH)2D), the active matabolite can enter the cell, bind to the vitamin D – receptor and subsequently to a responsive gene such as that of calcium binding protein. After transcription and translation, the protein is formed. The calcium binding protein mediates calcium absorption from the gut. The production of 1,25(OH) 2D is stimulated by parathyroid hormone (PTH) and decreased by calcium. (Lips P, 2006)

Everything from our geographical region and age to our race and sex can affect how much vitamin D we need to keep our body in the best working order.

Several health issues can result from the deficiency of vitamin D and they have been linked to different age groups, as well as, many geographical regions too. At present poor vitamin D status is a World Health concern, affecting nearly 42% of adults in the United States alone, with black and Hispanic people being most affected. (Lemond & Kennedy, 2019).

The signs and symptoms of vitamin D deficiency can be unnoticeable at the beginning; causing fatigue and even sadness as very generalized symptoms followed by severe bone pain and muscle weaknesses. In older adults, deficiency of vitamin D can cause Osteomalacia, resulting into falls, bone breaks, and poor healing following fractures. (Lemond & Kennedy, 2019)
An estimated one billion people worldwide suffers from vitamin D deficiency; mainly those living far from the equator, those having obesity, liver disease, celiac and renal disease. The elderly people and those with darker skin. (Greenblatt, 2011)

Deficiency of vitamin D has significant physical and psychological consequences. Every tissue in the body has vitamin D receptors, including the brain, heart, muscles and immune system. It plays a vital role in calcium absorption, apart from this vitamin D activities genes that regulate the immune system and release neurotransmitters like dopamine and serotonin, which affects brain function and development. (Greenblatt, 2011)

The psychological consequences of vitamin D deficiency are mainly:

DEPRESSION: Seasonal Affective Disorder (SAD), a mood disorder which is characterized by symptoms of depression occurs during the dark times of the year. The rainy season particularly in India, when the sunshine is absent for some consecutive days.

ANXIETY: Anxiety is another common problem found in people with vitamin D deficiency. the Presence of generalized anxiety is common among all age groups having vitamin D deficiency.

COGNITIVE IMPAIRMENT: Vitamin D receptors are present in the brain and promotes brain functioning and brain development. Vitamin D deficiency can result into minor to major cognitive impairments like memory loss, other distorted mental functions, difficulty in concentrating and many more.

LOWER WELL-BEING: Vitamin D deficiency can result into physical and psychological illnesses which affects the life of the individual. Physical illnesses like bone pain, teeth decay, indigestion, muscle pain, hair loss, cardiovascular diseases, migraine and many more accompanied by psychological disorders like acute depression, anxiety, cognitive impairments and mood disorder can lead to lower well-being. The individuals with vitamin D deficiency has low quality of well-being and as a result their quality of life gets negatively affected.

Epidemiological evidence has linked low vitamin D status to a range of mood disorders, including major depressive disorder, seasonal affective disorder and premenstrual syndrome. Several observational studies have found a strong positive link between vitamin D status or subclinical depressive symptoms. (Choukri, Conner, Haszard, Harper and Houghton; 2018)
And, adolescents with depression are also needed to elucidate the role of a vitamin D deficiency for mental disorders and to investigate the relevance of a routine assessment and supplementation of vitamin D deficits. (Focker, Antel, Grasemann, Fuhrer, Timmesfeld, Ozturk, Peters, Hinney, Hebebrand and Libuda; 2018)

Vitamin D is crucial not only for bone health but for proper brain development and psychological functioning. However, low levels of vitamin D are associated with depression, schizophrenia and also seasonal affective disorder in adults, but there is conflicting evidence about the relationship between vitamin D deficiency and psychological disorders. (Tamadon, Malek and Zahmatkesh; 2014)

And, there are other studies also conducted worldwide shows depression as a consequence of vitamin D deficiency. A study in Netherlands found that low levels of vitamin D correlated with symptoms of major and minor depression in 169 individuals ages 65 or older. An English study that included 2070 people age 65 and older concluded that vitamin D deficiency is associated with depression in northern countries, although major depression was only seen in individuals with the most severe deficiencies. In one study, adults with vitamin D deficiency who received high doses of the vitamin saw an improvement in their depressive symptoms after two months. (Greenblatt; 2011)

Study done on clients suffering from low vitamin D levels, may suffer from anxiety and as much as their vitamin D level is low, they are equally exposed to the chances of suffering from anxiety. (Hariri; 2016)

Deficiency of vitamin D affects the psychological health of an individual resulting into depression, anxiety and mood disorders, which altogether as a result decreases the well-being. The lowered well-being results into an unstable mental health and hampers the way an individual relates to the life.

Objectives of the study:

Vitamin D is a fat – soluble vitamin that the body produces when the skin comes in contact with the sunlight. It is present in lesser number of foods, including fortified products. When vitamin D enters the body, it is not in an active form, to use it, must be converted into 25 – hydroxyvitamin D (25(OH)D) or Calcidol.

Vitamin D is essential for a range of bodily functions. So, deficiency of the same in the body results into physiological and psychological health problems. The major physiological problems are related to bones and muscles. The psychological problems include depression, mood disorders, anxiety and lower well – being.

The present study aims at assessing psychological well–being, anxiety and depression of females – who are young adults and middle aged. As, vitamin D deficiency is highly prevalent and contributes to women's health greatly, getting too little vitamin D results into worse. It is one of the modern chronic diseases affecting women. So, the objective is to study the levels of psychological issues suffered by women of different age groups of Kolkata.

Methodology:

Sample and data collection: The present study has been conducted on females of Kolkata, falling within age groups of 20 to 35 (young adults) and 40 to 55 (middle age group). Each age group has three sub-groups divided according to the followed categories; females who are not suffering from vitamin D deficiency (doesn't have any of the past records of vitamin D deficiency, neither shows any of the physiological or psychological symptoms and has negative clinical report), the second sub-group includes females who have vitamin D deficiency but doesn't intake any medicine or supplements (has vitamin D deficiency of any type detected through blood test and shows more or less minimum one or two psychological and physiological symptoms). The third sub-group consists of females having vitamin D deficiency and intake medicines or supplements for the same (recommended by doctors).

INCLUSION CRITERIA: The inclusion criteria include; (1) Females of age groups 20 to 35 years and 40 to 55 years of age. (2) Females who reside within the city of Kolkata. (3) Females who do not have any past or present record of physiological and psychological disorders (other than vitamin D deficiency).

EXCLUSION CRITERIA: The exclusion criteria include; (1) Females of other age groups. (2) Females who doesn't reside in Kolkata. (3) Females who have partial symptoms of vitamin D deficiency or insufficiency of the same and not all of them. (4) Females having any major physiological or psychological disorders.

Data collection has been done with the help of a short information schedule and then followed by standardized questionnaires on the above-mentioned variables.

Description of tools: The present study assesses the psychological well-being, anxiety and depression of young adult females and middle age females.

Anxiety has been assessed with the help of **Generalized Anxiety Disorder 7-item scale.**
The 7 item GAD scale is a practical self-report questionnaire constructed by Spitzer RL, Kroenke K, Williams JBW, Lowbe B. in 2006.

It developed in a primary care setting to fill in the gap for having a brief measure for the assessment of GAD. The GAD-7 represents an anxiety measure based on seven items which are scored from zero to three. The whole scale score can range from 0 to 21 and cut-off scores for mild, moderate and severe anxiety symptoms are 5, 10 and 15 respectively. At the cut-off score of 10 both sensitivity as well as specificity exceed .0.8, so that the operating characteristic of the scale–based on using a structured psychiatric interview as the criterion—is satisfactory. Internal consistency of the GAD-7 was estimated at 0.92 and convergent validity was established by means of correlations with two other anxiety measures.

The GAD-7 provides a psychometrically sound instrument which can be incorporated as an economic and easily applicable instrument in primary care practices to single out patients with anxiety disorders with the ultimate aim to apply proper treatments and to reduce economic costs in the long-term.

Depression has been assessed with the help of **Beck Depression Inventory (BDI – II)**.
The BDI – II is a 21-item set instrument for measuring the severity of depression in adults and adolescence of 13 years and older. This version of the inventory was developed for the assessment of symptoms corresponding to criteria for diagnosing depression disorders listed in the American Psychiatric Association's DSM – IV (1994). It was developed by A.T. Beck, R.A. Steer and G.K. Brown in 1996.

The BDI – II presents few difficulties with respect to test administration and is a user friendly. In general, it requires between 5 and 10 minutes to complete. Patients with severe depression or obsessional disorders often take longer than average. And, in BDI – II, the time frame has also been extended to 2 weeks in order to be consistent with DSM – IV criteria for major depression.

Psychological wellbeing is assessed with the help of **P.G.I. WELL BEING MEASURE**.
P.G.I. Wellbeing Measure was constructed by Dr. S.K. Verma and Ms. Amita Verma in 1989. The scale consists of 20 items with easy instructions. This can be self-administered or can be verbally answered also. The scoring can be done by giving '1' for 'yes' response and '0' for 'no' response. Thus, the score varies from 0 to 20. Higher the score, higher is the wellbeing.
Test-retest reliability was measured applying K.R. 20 formula and was found to be 0.98. (Verma & Verma; 1989)

Result:

The result table below shows the result of t test done to assess the difference between normal individuals and individuals with vitamin D deficiency and who are taking supplements respectively, in terms of Wellbeing of both the age groups:

Table 1:

AGE GROUP	T test with	P value	SIGNIFINCANT/ INSIGNIFICANT
YOUNG ADULTS	VITAMIN D DEFICIENT	0.001	SIGNIFICANT
YOUNG ADULTS	WITH SUPPLEMENTS	0.05	SIGNIFICANT
MIDDLE AGED	VITAMIN D DEFICIENT	0.34	INSIGNIFICANT
MIDDLE AGED	WITH SUPPLEMENTS	0.31	INSIGNIFICANT

The result table below shows the result of t test done to assess the difference between normal individuals and individuals with vitamin D deficiency and who are taking supplements respectively, in terms of Depression of both the age groups:

Table 2

AGE GROUP	T test with	P value	SIGNIFICANT/ INSIGNIFICANT
YOUNG ADULTS	VITAMIN D DEFICIENT	0.00	SIGNIFICANT
YOUNG ADULTS	WITH SUPPLEMENTS	2.21	INSIGNIFICANT
MIDDLE AGED	VITAMIN D DEFICIENT	0.00	SIGNIFICANT
MIDDLE AGED	WITH SUPPLEMENTS	0.00	SIGNIFICANT

The result table below shows the result of t test done to assess the difference between normal individuals and individuals with vitamin D deficiency and who are taking supplements respectively, in terms of Anxiety of both the age groups: **Table 3**

AGE GROUP	T test with	P value	SIGNIFICANT/ INSIGNIFICANT
YOUNG ADULTS	VITAMIN D DEFICIENT	6.08	INSIGNIFICANT
YOUNG ADULTS	WITH SUPPLEMENTS	0.07	INSIGNIFICANT
MIDDLE AGED	VITAMIN D DEFICIENT	0.06	INSIGNIFICANT
MIDDLE AGED	WITH SUPPLEMENTS	0.30	INSIGNIFICANT

The table below gives us an outlook on the results of Pearson product moment correlation done to see whether there is any significant relation between psychological wellbeing and depression and anxiety in terms of young adult women:

Table 4

VARIABLES	SAMPLE	VALUE	CATEGORY
WELLBEING & DEPRESSION	NORMAL	-0.35	LOW CORRELATION
WELLBEING & DEPRESSION	VITAMIN D DEFICIENT	0.22	LOW CORRELATION
WELLBEING & DEPRESSION	WITH SUPPLEMENTS	-0.25	LOW CORRELATION
WELLBEING & ANXIETY	NORMAL	-0.38	LOW CORRELATION
WELLBEING & ANXIETY	VITAMIN D DEFICIENT	-0.28	LOW CORRELATION
WELLBEING & ANXIETY	WITH SUPPLEMENTS	-0.21	LOW CORRELATION

The table below gives us an outlook on the results of Pearson product moment correlation done to see whether there is any significant relation between psychological wellbeing and depression and anxiety in terms of middle age women:

Table 5

VARIABLES	SAMPLE	VALUE	CATEGORY
WELLBEING & DEPRESSION	NORMAL	-0.15	NEGLIGIBLE
WELLBEING & DEPRESSION	VITAMIN D DEFICIENT	0.35	LOW CORRELATION
WELLBEING & DEPRESSION	WITH SUPPLEMENTS	-0.12	NEGLIGIBLE
WELLBEING & ANXIETY	NORMAL	0.21	LOW CORRELATION
WELLBEING & ANXIETY	VITAMIN D DEFICIENT	0.09	NEGLIGIBLE
WELLBEING & ANXIETY	WITH SUPPLEMENTS	-0.04	NEGLIGIBLE

Discussion:

The slow and uneven changes occurring around the world has resulted in loosening our connection to nature. This distance is making us more attached to the virtual world and is transforming our lifestyle and tiny bit of habits. May it be our habit of communication, living or working, even our changing dietary habits; which has resulted in Hypovitaminosis D affecting almost half of the population throughout the world. Studies reveal that an approximate estimation of 1 billion people irrespective of all cultures, ethnicities and age groups are suffering from this insufficiency. This pandemic of deficiency and insufficiency of vitamin D is the consequence of the environmental factors and deteriorating life routines. The condition of Hypovitaminosis D is mainly perceptible in countries like Australia, The Middle East, India, Africa and South America.

Vitamin D deficiency has been defined as a 25(OH)D of less than 0.8 IU by the Institute of Medicine (IOM). Apart from lack of exposure to sunlight and insufficient dietary courses which fails to satisfy the need of vitamin D, being the important causes; people suffering from hepatic, renal, dermatological disorders, alcoholics and inflammatory rheumatological conditions can also have vitamin D deficiency or insufficiency. (Londhey; 2011) Individuals with darker skin tone are also at a higher risk for dearth of vitamin D due to low cutaneous synthesis and dairy poor diets.

Being a fat-soluble vitamin, its synthesis in the body is dependent on multiple factors like latitude, atmospheric pollution, clothing, skin pigmentation and duration and time of exposure to sunlight. (Londhey; 2011)

Irrespective of causes, vitamin D deficiency has vital medical and psychological outcomes. All the significant body parts including the brain, heart, muscles and immune system are formed with tissues having vitamin D receptors cells. Simultaneously it also plays a vital role in calcium absorption, vitamin D activates genes that regulate the immune system and release neurotransmitters like dopamine, serotonin – that affects the development and function of the brain.

Lower level of vitamin D in blood has also been related to the risk of heart attack, failure of heart, stroke, diabetes or high blood pressure. Current research studies are also concentrating on the relation between vitamin D deficiency and effect of coronavirus. Pregnant and lactating women having lack of vitamin D are linked to preeclampsia, gestational diabetes and adverse pregnancy outcomes.

Apart from these anatomical effects on the body, lack of vitamin D has some 'to be worried' bio-psychological consequences. As it is crucial for proper brain development and psychological functioning; low vitamin D concentration is associated with psychological disorders. (Asl, Tamadon, Malek and Zahmatkesh; 2014) One of the most noticeable of them is depression. Researchers have concluded that cells having vitamin D receptors present in the regions of the brain, is the same area that is also attached with depression. Though depression has a vivid number of causes, deficiency of vitamin D is a lesser important one, but it certainly impairs and prolongs or delays the recovery.

The next in the list of psychological disorders is Anxiety. Deficiency of vitamin D can lead to chronic anxiety. And, changing levels of vitamin D_3 promotes symptoms of Seasonal Affective Disorder. SAD shows overlapping symptoms with depression, but unlike people with depression, SAD affected do not have thoughts of hurting themselves or feelings of worthlessness. The visible symptoms are sleepiness, craving carbohydrates, difficulty with concentration, depressed mood, anxiety, irritability, weight gain, lethargy, decreased libido and Hyperphagia. It occurs mainly due to lack of exposure to sunlight for a continuous long period. (Saleh; 2015)

In recent years, vitamin D deficiency has been linked to a host of conditions, including osteoporosis, heart disease, diabetes, certain cancers and autoimmune diseases. (Mann; 2012) Depression and chronic anxiety accompanied with these physiological issues results in depletion of one's mood, cognitive impairments and SAD. Physical illness like bone pain, teeth decay, indigestion, muscle pain, hair loss, cardiovascular diseases, migraine and many more leads to the bottommost state of wellbeing.

In the present study, women of two particular age groups have been included, one is the young adult and other is middle age group. These two groups of women with 60 individuals each were subdivided into three sub-groups and categorized as normal (who does not show any symptoms of having low vitamin D or has been tested negative), second ones are with vitamin D deficiency (medically tested) and the third one are those who have been diagnosed with Hypovitaminosis D and are taking supplements, as per their doctor's recommendations. Anxiety and depression of these individuals have been measured, and the effect of both on their psychological wellbeing has also been observed.

To measure the difference between the groups individually with their normal counterparts, t test has been performed. The Statistical data in case of young adults shows that there is a highly significant difference in terms of psychological wellbeing when the normal counterparts are compared with their vitamin D deficient ones. A detailed study of the data shows that young adult females with hypovitaminosis D have poor wellbeing, where the score reaches almost to the baseline. In case of middle age women there is no significant difference being observed when normal individuals are compared with women having vitamin D deficiency. But a significant difference has been seen when the normal individuals are differentiated with the

middle-aged group taking supplements in terms of wellbeing. The mean difference in this case shows that the latter group has a better Quality of Life and wellbeing than the former one. A recent study report on vitamin D and mood disorders of women, also suggests that vitamin D may be an important nutrient for women's physical and mental wellbeing. (Murphy and Wagner; 2008) In addition to this, lower levels of vitamin D have been noted with other mental disorders also. (Scheider, Weber, Frensch, Stein and Fritze; 2000)

When depression as a variable has been studied, there is a high significant difference visible between the normal young adult women and women with vitamin D deficiency. The second group has scored really high in the BDI scale, depicting the change in their behavioural responses which matches symptoms of depression. They have reported that depression sources from loss of energy and regular fatigue which leads them to mistakes in work places, lack of pleasure in life, ill health due to insufficient vitamin D, anxiety and negative thoughts. Infact, 1% of the sample has also reported that they have suicidal ideations at least once in two to three months. But, in case of women who intake regular supplements show no significant difference in terms of depression with that of their normal counterparts. When depression is measured and assessed in case of middle-aged women, both the groups differ significantly with the normal ones. They have scored high in the BDI scale. When the responses are observed keenly, a number of different causes has come up other than dearth of vitamin D. Loss of pleasure, increased irritability, changes in sleeping pattern, family responsibilities, guilt of past failures and losing of interest in sex life is affecting the psychological health. The monotonous life leading them towards mental fatigue, self-dislike, self-criticalness, worthlessness even results in suicidal thoughts. All these negative feelings promote depression in the two groups other than the normal one, because deficiency of vitamin D provokes depression and stretches the recovery. A study including 12,600 people aged 20 to 90, assessed symptoms of depression and measured the vitamin D in their blood. People with the lowest level of vitamin D were more likely to report symptoms of depression, compared to people with higher blood levels of vitamin D. This relationship was strongest among people with a history of depression. (Mann; 2012) Another study shows a high rate of depression for those individuals with vitamin D deficiency when compared to those with insufficient or normal levels of vitamin D. (Armstrong, Meenagh, Bickle, Lee, Curran and Finch; 2007) And lastly, another study reveals that persons with secondary hyperparathyroidism, lower serum vitamin D, were significantly related to higher scores on the BDI scale when compared to controls. (Jorde, Waterloo, Saleh, Haug and Svartberg; 2006)

Lastly, there are no significant differences that can be observed in case of anxiety among the groups of young adult women. And also, no significant differences are present in case of middle age females. There are a number of studies showing that low vitamin D in blood level aggravates Anxiety. But there are studies which also show a minor or almost no relationship between these two. We can see that many results of research into the link between anxiety and vitamin D have produced mixed results, so further studies are needed to explore. (Medical News Today; 2019)

The relationship between the variables has also been studied, with the help of Pearson r correlation. The psychological wellbeing is inversely proportional to depression and anxiety. Both of them have a negative effect on the positive mental health of an individual. In the case of young adult women, their depression has a significant effect on their wellbeing. The result is similar also in the case of anxiety. But the group which intakes supplement regularly has shown a less effect of depression and anxiety on their mental health. The middle age women, who fall in the normal category and individuals who consume regular supplements of vitamin D depicts almost no effect of depression on their wellbeing. That is because depression is not the only cause behind their ill mental health. The group with vitamin D deficiency shows a significant relationship between the two variables. In case of anxiety, it has a negligible effect on their mental health and wellbeing. A study research shows a relationship between vitamin D deficiency and symptoms of depression. Although, it is still under study that low vitamin D levels are the cause or the effect of depression. There are several factors which hamper the studies regarding it, including the fact that lack of vitamin D is just one of the many factors that may contribute to depression. (Cuomo, Giordano, Goracci and Fagiolini; 2017) Another study shows that low vitamin D intake is associated with poorer Quality of Life compared to women with higher intakes. (Motsinger, Lazovich, MacLehose, Torkelson and Robien; 2012) Various studies from different parts of India have highlighted that vitamin D insufficiency or deficiency across different age groups range from 70 - 100%. Adult females, particularly those above 40 years of age, are mostly affected because vitamin D determines the pattern of post - menopausal bone loss and age-related osteoporosis.

Consumption of supplements according to the prescribed dosage is very essential in improving the condition. This silent epidemic has to be checked in some way. The present study shows a clear picture of the evidence of supplements in improving not only physical but also the psychological health of women. Anxiety and Depression both can be checked and as a result wellbeing evolves. Another study shows weekly administration of 50,000 IU D_2 in women with T2DM who had significant depressive symptoms and low 25(OH)D levels had an improvement in depression, anxiety and mental health outcomes. (Penckofer, Byrn, Adams, Emanuele, Mumby, Kouba and Wallis; 2017) A pooled analysis shows a significant reduction in Beck Depression Inventory (BDI) score following supplementation with vitamin D. (Jamilian, Amirani, Milajerdi, Kolahdooz, Mirzaei, Zaroudi, Ghaderi and Asemi; 2019) Another study says taking 50,000 IU vitamin D supplements every 2 weeks for 24 weeks by patients under MMT had beneficial effects on cognitive functions and some mental health parameters. (Ghaderi, Amir, Azad, Morad, Farhadi, Hassan, Mirhosseini, Naghmeh, Motmaen, Maryam, Pishyareh, Ebrahim, Omidi, Abdollah, Asemi and Zatollah; 2020)

Conclusion:

The above discussion has led us to the conclusion that Hypovitaminosis D though not the ultimate cause for depression and anxiety, but certainly a crucial factor in promoting these two mental health issues and also delays their recovery. The vitamin D receptor cells present in our body, if not work appropriately, will affect not only the physical health but also the psychological health. There are already varied causes aggravating depression and anxiety in women of different ages which sources from their social, work and family life; so, if the deficiency of vitamin D is cured, they can deal with their psychological issues with more ease. The inclusion of supplements in one's life will help the women of all ages who are vitamin D deficient in improving the physical health, to increase their immunity to fight against the current spreading viruses as well as their mental health conditions leading them towards a healthy lifestyle.

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