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RESEARCH ARTICLE

IMPACT OF VITAMIN D DEFICIENCY ON MENTAL HEALTH OF MAURITIAN POPULATION-A PILOT STUDY

Dr. T. Ibrahim[1], Dr. S. Peerally[2], K.R. Soopal[3], M.N. Jannoo[4]and A. Gupta[5]

1. General Practitioner, MBBS, MPH Mauritius.
2. General Practitioner, MBBS, MPH Mauritius.
3. Medical Student at SSRMC.
4. Medical Student at SSRMC.
5. Medical Student at SSRMC.

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Abstract

In this work, we aim to study any relationship between vitamin D deficiency and the prevalence of depression in the population of Mauritius aged between 18 and 40 years. The objectives are to identify the prevalence of depression in vitamin D deficient individuals, and to identify the impact of the level of vitamin D deficiency on the severity of depression. A survey was carried out on 25 individuals who were tested as vitamin D deficient by means of questionnaires. Statistical analysis was performed using SPSS, version 24. The resulting data showed that nineteen, 19 of the participants were suffering from depression and a strong relationship between severity of vitamin D deficiency and the severity of depression was noted (Pearson correlation coefficient, r -0.908).The study therefore calls for reinforcing efforts in terms of screening for depression as well as for vitamin D deficiency.

Introduction:-

Depression, the most common mental health disorder, is currently affecting more than 300 million people worldwide (WHO, 2019) and it imposes a substantial health and economic burden which makes it one of the very important disorder covered by WHO's mental health Gap Action Programme (WHO, 2018). It is an important leading cause of preventable morbidity and premature mortality (WHO, 2019), but, when left untreated or poorly treated, its consequences are devastating; for instance, it costs America $210.5 billion/year and globally it is accountable for 7.5% of all years lived with disability in the year 2015 (workplace mental health 2019). In terms of health consequences, it increases the prevalence or worsens numerous conditions such as heart problem, diabetes, substance abuse disorder and it has been found liable for about 20% of all suicide cases each year between 2000 and 2011 (Nordtet al. 2015).

Several pre-disposing factors have been incriminated in the development of depression which includes genetic predisposition, gender, social environment, stress, life events, vitamin D deficiency, unemployment, financial problems, loss of close ones, physical and sexual abuse among others (WHO 2012; McGee & Thompson 2015).

Corresponding Author:- Dr. T. Ibrahim
Address:- General Practitioner, MBBS, MPH Mauritius.

Vitamin D is now considered more as a hormone rather than a vitamin. It has several roles in maintaining a healthy state. The detrimental effect of vitamin D on mental health and its association with depression is gaining importance recently. Multiple research works have been conducted to examine the relationship between vitamin D and depression along with other disorders like SAD (seasonal affective disorder) and schizophrenia. The results of many such studies have shown an inverse relationship between level of vitamin D and mood (Penckofer*et al.* 2010; Berridge 2017; Aghajafari*et al.* 2018; Kamalzadeh*et al.* 2021). Studies have shown that vitamin D down regulates inflammatory mediators which have a protective role in the development of psychosocial stress, depression and sickness behaviours (Aghajafari*et al.* 2018; Kamalzadeh*et al.* 2021). Moreover, it also regulates neuronal calcium ion level, serotonin level by inducing expression of serotonin synthesizing gene, tryptophan hydroxylase 2 while repressing expression of tryptophan hydroxylase 1 and regulates parathyroid hormone level (Penckofer*et al.* 2010; Aghajafari*et al.* 2018; Kamalzadeh*et al.* 2021). The above parameters have been implicated in the development of mood disorders and depression.

In Mauritius, mental health disorder is becoming a growing public health problem and the situation is alarming as evidenced by recent statistical data; it has been reported that16.7% of the surveyed population suffered from depression in the year 2015 (WHO Biennium report 2017/2018 2019), 2.84% of the population suffered from severe mental health or substance abuse disorder in the year 2016 (Ramphul 2018) and the suicide rate in Mauritius is 7.3 per 100,000 population which is substantial (WHO, 2016). The underlying problem can actually be worst as these statistical values are likely to underestimate the actual health burden since mental health disorders including depression is likely to go unreported or under-reported because of stigmatization (Ramphul 2018). In view of the above, it is thus advisable to protect and improve the mental health of the population in order to have a more flourishing future of the country. One of the foremost way of promoting health including mental health is by reducing the social inequities in health (WHO 2019) and addressing the various precipitating factors leading to depression; for instance, screening the population for vitamin D deficiency and providing the treatment for the same can improve the mental health of the population. At present, several patients presenting to the private health care with features of depression, bone pain or recurrent infections and when screened for their vitamin D level, have been found to be deficient. Since vitamin D deficiency has been consistently linked with elevated prevalence of depression and the fact that no study has been done in our knowledge to find any association between vitamin D deficiency and depression in Mauritius, undertaking this study therefore aims at filling the gap in the literature. In addition, this study is expected to help in understanding the implication of vitamin D deficiency on the mental health of the Mauritian population such that a tailor-made intervention package can be made in view of mitigating the prevalence of depression in the country.

The aim of the study is to assess the relationship between vitamin D and the prevalence of depression in the Mauritian population.

The main objectives of the study are:

1. To estimate the prevalence of depression in the Mauritian population aged 18 years to 40 years who are vitamin D deficient.
2. To evaluate the correlation between degree of vitamin D deficiency and the severity of depression.

Methodology:-

Research approach:

A quantitative research method was used. It makes use of statistical data as a tool for saving time and resources.

Research design:

A cross-sectional study has been employed. It is a relatively quick and inexpensive method allowing the study of the relationship between an exposure factor and outcome at one and the same time. There is as well no loss of patients due to follow-up.

Target population:

Vitamin D deficient Inhabitants (both genders) of Mauritius aged between 18years and 40 years attending a private clinic in Mauritius. The population was mixed including Hindus, Muslims and Catholics. Data was collected over a 6 months period: January 2022 till June 2022.A patient was considered to be vitamin D deficient when the level of vitamin D was < 30ng/ml.

Inclusion criteria:
Resident of Mauritius aged 18 years to 40 years.

Exclusion criteria:
1. Non-Mauritian Nationality
2. Patient admitting to have a known stressful situation
3. Residents of Mauritius less than 18 years or more than 40 years
4. Individuals with established diagnosis of mental health disorders, cancer, neurological diseases and endocrine diseases (thyroid and adrenal disorders).
5. Individual on medications that are highly liable to cause mood changes such as beta blockers, corticosteroids, nasal decongestants, aminophylline, antihistamines and thyroid hormones.

Sampling and sample size
Twenty-five (25) participants (who are vitamin D deficient) have been recruited through convenience sampling method from a private clinic located in Port Louis.However, the participants come from different regions of Mauritius. A private clinic was used as it is easier to get access.
The study sample comprised of 12 males and 13 females.

Data collection
Data was collected through a self-administered questionnaire. This questionnaire contained a set of closed-ended questions that was divided into two sections. The questions were meant to collect demographic data and to assess the mental health status of the respondent. The questionnaire was developed based on the research objectives and current literature on vitamin D status, mental health status and depression.

Along with the questionnaire, a cover letter was attached. The cover letter was to introduce the research topic to the participants and to neutralise any doubts or mistrust about the topic. It also helped to motivate the participants to answer the questions and ensured anonymity and confidentiality.

The respondents were informed that the participation is voluntary. The participants were reassured that confidentiality and anonymity of the participants will be maintained. Once they gave their written consent, then the questionnaire was handed to them.

Data collection tool
The questionnaire was designed such that it is reliable and valid. It consists of two sections: Section A was meant for assessing the demographic profile and it was self-designed. It consisted of six questions namely, questions pertaining to:
1. Gender-"what is your gender?" with answer options "male" and "female".
2. Age-how old are you?
3. Ethnicity- 'What is your ethnicity?' with answer options-'Mauritian' or 'others'.
4. What is your level of vitamin D?
5. Medical history
6. Pertaining to drug history

During design, we have worked towards the validity of the questionnaire by asking relevant questions that the research was intended to test in such a way that the respondent understood the objective of the questions. Questions were designed such that they were not ambiguous as well as the items of the questionnaire had a good inter-relatedness among them. We have also tried to limit confounding factors which may affect the result.

Section B was adapted from CUDOS –D to screen for depression and its severity. The CUDOS – D questionnaire was chosen for this study as it was found to have a high internal consistency with a high Cronbach's alpha (Cronbach's alpha at intake = 0.82; Cronbach's alpha at follow-up = 0.93), a good test-retest reliability coefficient of $r = 0.91$ at intake and r =0.98 at follow-up (Zimmerman et al, 2018) and is a valid instrument. Furthermore, this tool is brief and user friendly. It can be completed in 2-3 minutes and scored within15 seconds (Zimmermanet al, 2008).

This tool consists of 18 items and only the first 16 items which assess the DSM-IV MDD symptoms (section B of the tentatively designed questionnaire for the current study) were included. The CUDOS D uses a scoring system to screen for the presence and severity of depression. The total scores range from 0-64.

A likert scale was used for scoring each of the 16 questions. Each question was given 5 options namely: Not at all (score=0), rarely (score=1), sometimes (score=2), often (score=3) and almost always (score =4) (Zimmerman 2008).

The scores can be interpreted as follows:

Depression severity	**CUDOS score range**
Non-depressed	0-10
Minimal depression	11-20
Mild depression	21-30
Moderate depression	31-45
Severe depression	46 and above

For assessing the prevalence of depression, a participant was considered to be depressed when the CUDOS score was more than 10.

Measurements of variables

Outcome variable

The outcome variable for this study was depression. Depression was assessed using the CUDOS questionnaire as described above.

Main Independent variable

Vitamin D status was the main independent variable in this study and it was assessed by using one question: 'what is your vitamin D level (measured from whole blood in a quality assured laboratory)?'

Data management and analysis

The questionnaires were examined for completeness and accuracy and then all questionnaires were coded and entered into a computer.

SPSS, Version 24 was used for data analysis. The internal consistency of the questionnaire was measured using Cronbach's alpha coefficient (Tavakol et al. 2011). Descriptive statistics and correlation analysis was used for analysing the data. Correlation analysis was performed to analyse the relation between duration of unemployment and CUDOS score, which assess the severity of depression (Stankunas et al. 2006).

Results of the study:-

The study sample consisted of 25 participants: 12 males and 13 females. The findings of the study showed that 72 % of the participants were suffering from undiagnosed depression which is a serious threat, both in terms of health and economic burden. The gender-based prevalence of depression revealed that 67% of the male participants and 77% of the female were depressed as illustrated in Table1.

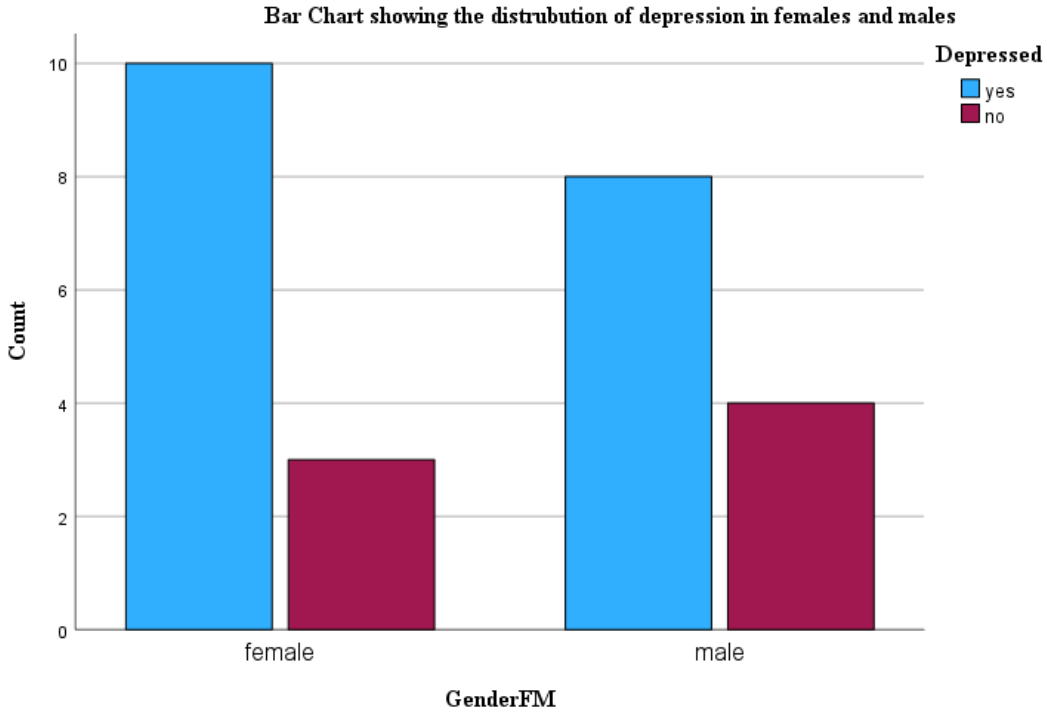

Table 1:- Prevalence of depression (gender-based).

A correlation analysis was done to assess the relationship between the severity of vitamin D deficiency and the severity of depression. It was found that the lower the level of vitamin D was, the higher the CUDOS score was (severity of depression increases). The Pearson Correlation coefficient, *r*, was found to be – 0.908 which showed that there was a linear relationship with a large negative strength of association between the two variables- severity of vitamin D deficiency and severity of depression (CUDOS score).

Correlations

		VitDlevel	Cudosscore
VitDlevel	Pearson Correlation	1	-.908**
	Sig. (2-tailed)		<.001
	N	25	25
Cudosscore	Pearson Correlation	-.908**	1
	Sig. (2-tailed)	<.001	
	N	25	25

**. Correlation is significant at the 0.01 level (2-tailed).

Discussion and contribution of the study:-

1. The study is in agreement with several studies which show an association between depression and vitamin D deficiency.
2. From this study, we found that depression is a disorder of public health concern which is under-diagnosed in Mauritius; thus, the need for robust mental health promotion and prevention measures need to be considered.
3. The study has provided an understanding about the fact that vitamin D deficiency can be considered as one of the important precipitating factor leading to depression in Mauritius. Furthermore, it adds to the growing evidence that as severity of vitamin D deficiency increases, the severity of depression also increases.

4. It helps in fulfilling one of the objectives of the World Health Organization (WHO), Department of Mental Health and Substance Abuse, which is reducing the health burden associated with mental, neurological as well as illicit drug abuse disorders through mental health promotion strategies.

Limitation of the study

The findings of this study cannot be generalised to the whole population of Mauritius since the sample size used was very small and not representative of the population such that further research is needed in order to have a finding that is representative. Moreover, it is not possible to make a causal inference as a cross-sectional study design was used.

Recommendations:-

In view of the findings of the study, the following measures are recommended:

1. General sensitization and awareness campaign about mental health disorders and depression such that the affected individuals can seek help as early as possible (Eaton *et al.* 2017; Griffiths *et al.* 2016).
2. Routine screening for vitamin D deficiency may be implemented in patient suffering from depression. The test should be made more accessible to all.
3. Measures for prevention (primary, secondary and tertiary) of vitamin D deficiency such as awareness and sensitization about the need of a balanced diet and educating the population about the dangers of vitamin D deficiency and the clinical features of early manifestation of vitamin D deficiency.
4. Mental health screening programme and suicide prevention strategies for the general population need to be promoted along with appropriate and accessible treatment facilities (Warner *et al.* 2011; Gardner 2014).
5. Promote research in the field

Conclusion:-

Depression is a pervasive problem of public health concern which is contributing to high rate of morbidity and mortality worldwide and the findings from this study strongly suggest that vitamin D deficiency has a significant influence on the prevalence of depression in the Mauritian population which in turn highlights that vitamin D deficiency also has to be treated as a public health problem. The findings of the study therefore make an appeal for the implementation and reinforcement of mental health preventive and promotion measures, for instance, through the development of mental health screening program and by easing access to social interventions in Mauritius as current investment in this field will prove cost-effective in the future. This can be achieved via a well-coordinated, integrated, life-course, multi-dimensional and multi-sectoral approach whereby public sectors, private sectors, national and international NGOs and stakeholders have to work together to promote the most effective universal and high risk preventive approach for the benefit of the Mauritian population.

Ethical consideration:

Informed consents and permission was taken from the participants of the survey. All data has been treated with strict anonymity and confidentiality. All journals and materials used for this paper are clearly referenced.

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Conflict of interest:

The authors have no conflict of interest to declare.

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