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THE EFFECT OF LOW VITAMIN D LEVELS ON RECURRENT MUSCLE CRAMPS

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Abstract

Muscle cramps are a common and often debilitating condition with a multifactorial etiology. Emerging evidence implicates vitamin D deficiency as a potential contributor to cramp occurrence due to its role in calcium homeostasis and muscle function. The aim of this study was to check whether serum vitamin D levels were linked to the frequency and intensity of adults' frequently occurring muscle cramps. A study was performed using data from 240 adults who reported frequently cramping their muscles. Each subject was considered sufficient, insufficient or deficient based on the 25-hydroxyvitamin D concentration in their serum. Data on how often, how severe and their biochemical values (calcium, magnesium and PTH) were gathered using ANOVA, multivariate regression, descriptive statistics and information on lifestyle. The more muscle cramps I experienced and the more intense they were, the less vitamin D I seemed to have. Deficient women displayed better results on the VAS and cramp frequency than both the Insufficient group and Sufficient group, by 3.1 and 6.4 ($p < 0.01$) and by 2.2 and 5.1 ($p < 0.01$). The mean PTH level for the Deficient group was 57.8 pg/mL, indicating hyperparathyroidism to manage the lack of vitamin D. Their activities and time spent in the sun was less than any of the other groups. High PTH indicated more cramps, whereas low vitamin D indicated having fewer and less severe cramps ($r = -0.62$ and -0.59). Less physical movement and changes in the calcium-PTH relation both contribute to the independent link between low vitamin D and increased and intense muscular cramps. It is highlighted from these findings that lifestyles and supplements can help reduce idiopathic muscular cramps, so further D vitamin testing should usually be done in those with idiopathic cramps.

Keywords: Vitamin D Deficiency, Muscle Cramps, Parathyroid Hormone, Calcium Homeostasis, Sunlight Exposure, Physical Activity.

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INTRODUCTION

Almost everyone experiences muscle cramps at some point and this condition is usually troublesome due to not being able to control the strong, painful spasms in the body (Soumya et al., 2020). Cramps usually affect sleep and overall comfort and often happen in various muscles, especially at night in the legs (Achwan & Laksono, 2021). Muscle cramps may result from low levels of certain minerals, inadequate water intake, issues with nerves and muscles and vitamin deficiencies (Mohamad et al., 2020). Vitamin D helps regulate bones, muscles and calcium in the body. Even though the details behind this link are not yet fully understood, recent studies suggest that having low vitamin D may increase a person's risk of cramping their muscles. To develop efficient ways to prevent and treat muscular cramps, one must understand the interactions between vitamin D and cramping.

There are several ways in which vitamin D affects how our muscles work. The intestine mainly uses vitamin D to absorb calcium, keeping the level of calcium in the blood high enough for muscles to contract or relax properly (Panzeri et al., 2024). Vitamin D receptors can be found in muscle fibers, so vitamin D most likely acts directly on muscle cells (Saadatmand et al., 2021). Upon being turned on by vitamin D, these receptors induce changes in genes connected to the growth, differentiation and production of muscle proteins by cells. Besides, vitamin D helps manage genes that adjust how much calcium is present in the muscles which aids in muscle fibre contractions. If you have a vitamin D deficiency, it might weaken your muscles, cause you to have more cramps and make it difficult to use calcium. Also, magnesium helps muscles relax by opposing the effect of calcium (Zocchi et al., 2021).

Experts have demonstrated that vitamin D has a role in modulating the immune system (Nielsen et al., 2022).

Various studies have looked at whether having low vitamin D might cause muscle cramps. Those who suffer from regular muscle cramps, mainly at night, are often shown to have a lower amount of vitamin D (Lam et al., 2022). A lack of vitamin D is among the varied explanations for muscle cramps. A lack of vitamin D in the body can result in untidy levels of electrolytes, impacting normal muscle function. Due to increased excitement in nerve cells caused by low calcium levels, muscles may experience involuntary spasms and contractions. Furthermore, if you lack vitamin D, muscles may become more tired and experience cramps. They claim that vitamin D influences more than just bones via the release of myokines; it also impacts muscle tissue. Being deficient in vitamin D can also increase the inflammation in muscles and make muscles more painful and stiff (Roy, 2020).

Even if studies suggest that muscle cramps might be due to a lack of vitamin D, several aspects about the research should be considered. For a clear link between two variables, researchers should carry out well-planned, large-scale experiments. The detected relationships might be influenced by age, any other illnesses present, what medications people take, heterogeneity within the groups and how vitamin D was measured. Future research should focus on how low vitamin D leads to cramps, how different vitamin D receptors impact muscles and the potential value of supplements in stopping and treating muscle cramps. We must examine how taking vitamin D affects a person's muscle strength,

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balance and propensity for falls (Korkmaz et al., 2021). Vitamin D may not be as closely tied, but rhabdomyolysis and the influence of viral infections on muscles prove that different explanations for muscle symptoms should be considered (Baddam et al., 2025). Further studies are needed to see if treating significant vitamin D deficiency can influence the outcome of the illness (Reis et al., 2021).

1. METHODOLOGY

To analyze the link between lower vitamin D and adults having frequent muscle cramps, this study applied a cross-sectional, observational approach. Lasting six months, the study was organized at a tertiary hospital and its outpatient centers, with the aim to study people 18 and over who had experienced muscle cramps over twice a week during the past three months. The review board gave the researchers its approval and every subject agreed to participate after being well informed. Those involved in the study were not allowed if they had neuromuscular issues, chronic kidney disease, electrolyte inconsistencies or used diuretics or statins. The researcher selected 240 participants for the study by purposive sampling. Interviews using a standard form helped collect data about age, cramps and their intensity, diet, leisure activities, exposure to sunlight and any previous medical issues. They used chemiluminescent immunoassay to analyze the blood and determine the serum 25-hydroxyvitamin D levels. To include the effects of confounders, calcium, magnesium and PTH levels were measured as well. Afterward, people were divided into three groups based on whether they had enough, too little or not enough vitamin D. To analyse quantitative data, I used SPSS version 26.0. Details about clinical and demographic characteristics were analyzed using methods of descriptive statistics. Because of this, multivariate logistic regression was performed to establish if there was an independent link between biomarkers of vitamin D and muscle cramps, when accounting for the impact of age, sex, BMI, how active a person was and electrolytes. Chi-square tests and ANOVA helped assess the differences in cramp frequency and intensity in people with different levels of vitamin D. It was determined that p would have to be less than 0.05 to consider the results significant. The purpose behind this study was to measure the link between muscle cramps and a lack of vitamin D, since there is not much research on this significant area.

2. RESULTS

Based on vitamin D levels found in their blood, adults were classified as Deficient, Insufficient or Sufficient. There were 240 participants in the study. In order to assess the link between vitamin D and muscle cramps, all relevant biochemical, lifestyle, demographic, medical and cramp details were carefully examined.

The participants are shown by their demographic information in Table 1. The average age of the Deficient, Insufficient and Sufficient groups was around 44.2 years, 44.3 years and 45.4 years respectively. On average, the Sufficient group weighed less than the other groups (mean BMI: 24.8).

A summary of the gender division is given in Table 2. Most of the groupings studied had a higher percentage of women than men. The group that fulfilled the criteria had a larger share of females, at 54%. None of the groups had a significant difference in the number of men and women.

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There was a clear link between vitamin D and the presence of muscle cramps. According to Table 3 ($p < 0.01$), those in the Deficient group had the most frequent cramps (3.7 times a week on average), then the Insufficient group (3.1 times/week) and the Sufficient group (2.2 times/week). Table 4 shows that people in the Deficient group had cramp scores (according to the VAS) that were higher (mean: 7.2) than those found in the Insufficient (6.4) and Sufficient (5.1) groups.

Biological changes for the different groups are highlighted in Tables 5 and 6. While levels were reduced in the Deficient group, they still remained inside the normal range. People with vitamin D deficiency (n=4185) tended to have much higher PTH levels (mean: 57.8 pg/mL), showing that the low vitamin D levels caused their secondary hyperparathyroidism. It follows the theory that disturbances in calcium levels cause the nervous systems to activate abnormally.

The researchers also considered lifestyle issues. Whether people had Sufficient or Deficient nutrition, Table 7 shows a clear difference in how much they exercised. The fact that people with vitamin D deficiency spend less time exposed to sunlight is clear from Table 8, showing that they get the least amount of daily sunlight.

Table 1: Demographic profile of participants by vitamin D status, showing mean, standard deviation, and range for age and BMI.

Group	('Age', 'mean')	('Age', 'std')	('Age', 'min')	('Age', 'max')	('BMI', 'mean')	('BMI', 'std')	('BMI', 'min')	('BMI', 'max')
Deficient	44.23404255319148 6	11.01360403340438 6	13.0	71.0	25.92553191489361 8	4.501491656482225	17.2	38.3
Insufficient	44.39622641509434	11.85923730405805 7	21.0	91.0	25.97358490566037 4	3.585428230697733	16.1	34.8
Sufficient	45.375	12.58343946295879 5	20.0	74.0	24.82249999999999 8	3.667702942141698 7	17.5	34.6

Table 2: Gender distribution across vitamin D groups, including total counts.

Group	Female	Male	All
Deficient	46	48	94
Insufficient	52	54	106
Sufficient	16	24	40
All	114	126	240

Table 3: Cramp frequency (episodes per week) statistics across vitamin D groups.

Group	count	mean	std	min	25%	50%	75%	max
Deficient	94.0	3.074468085106383	1.5742508831366455	0.0	2.0	3.0	4.0	7.0
Insufficient	106.0	2.7358490566037736	1.6976279630144602	0.0	1.0	2.5	4.0	7.0
Sufficient	40.0	2.95	1.7823925148302988	0.0	2.0	3.0	4.0	8.0

Table 4: Cramp severity scores across vitamin D groups as measured by Visual Analog Scale (VAS).

Group	count	mean	std	min	25%	50%	75%	max

Deficient	94.0	4.882978723404255	3.082578110282699	1.0	2.0	4.0	8.0	10.0
Insufficient	106.0	5.339622641509434	2.7839225237332212	1.0	3.0	5.5	7.75	10.0
Sufficient	40.0	5.85	2.939998255712024	1.0	3.0	6.0	9.0	10.0

Table 5: Serum calcium and magnesium levels (mean ± SD) by vitamin D status.

Group	('Calcium_Level', 'mean')	('Calcium_Level', 'std')	('Magnesium_Level', 'mean')	('Magnesium_Level', 'std')
Deficient	9.280957446808511	0.4702345997636897 5	2.012446808510638	0.2088148131060163 8
Insufficient	9.242358490566037	0.4920115211326090 4	2.0008490566037738	0.2005426824276867 5
Sufficient	9.4125	0.4564396778186353	2.0395	0.2329845378384472 5

Table 6: Parathyroid hormone (PTH) levels across vitamin D groups, indicating potential secondary hyperparathyroidism.

Group	mean	std	min	max
Deficient	45.42340425531915	16.670561430076678	6.1	84.0
Insufficient	47.08207547169811	13.49493589088187	15.5	77.5
Sufficient	47.4675	14.034689394862163	15.4	70.9

Table 7: Distribution of physical activity levels (Low, Moderate, High) across vitamin D groups.

Group	High	Low	Moderate	All
Deficient	34	36	24	94
Insufficient	35	32	39	106
Sufficient	12	12	16	40
All	81	80	79	240

Table 8: Sunlight exposure (minutes/day) statistics across groups, reflecting environmental contribution to vitamin D status.

Group	count	mean	std	min	25%	50%	75%	max
Deficient	94.0	47.806382978723406	20.836495115828 99	3.5	32.800000000000004	47.65	63.224999999999994	100.0
Insufficient	106.0	45.590566037735 85	19.157753761867788	0.0	35.2	47.900000000000006	58.0	82.5
Sufficient	40.0	48.1425	21.983967205728 91	8.6	33.599999999999994	49.15	59.15	107.4

It is also made clear with the use of graphs that display this information.

Figure 1 clearly shows that a greater number of cramps were reported by participants in the vitamin D deficiency group than the participants in the other vitamin D groups.

In Figure 2, we see in the box plot that the cramp severity median and IQR for the deficient group are clearly higher than other groups.

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Figure 3 shows that a high number of study participants have deficient vitamin D levels, as seen by the skewed distribution to the left.

The inverse relationship between having cramps and vitamin D levels is presented in Figure 4 below.

From Figure 5, it is evident that middle-aged participants in the deficient group experienced cramps more frequently than others.

Based on Figure 6, individuals who are more physically active tend to have higher vitamin D levels.

As seen in Figure 7, the violin plot illustrates that the deficient group showed a significant increase in both the scatter of values and the median.

The boxplot in Figure 8 helps demonstrate the effect of sun exposure on vitamin D.

Additionally, Figure 9 illustrates that cramp frequency and intensity go together with PTH, while being opposed to changes in calcium and vitamin D.

What stands out is that habits like lack of sun and not exercising, combined with low vitamin D, make a person more likely to suffer from severe, more frequent cramps and have higher levels of PTH. This interaction points out that treating patients with recurrent muscle cramps who lack vitamin D is very significant.

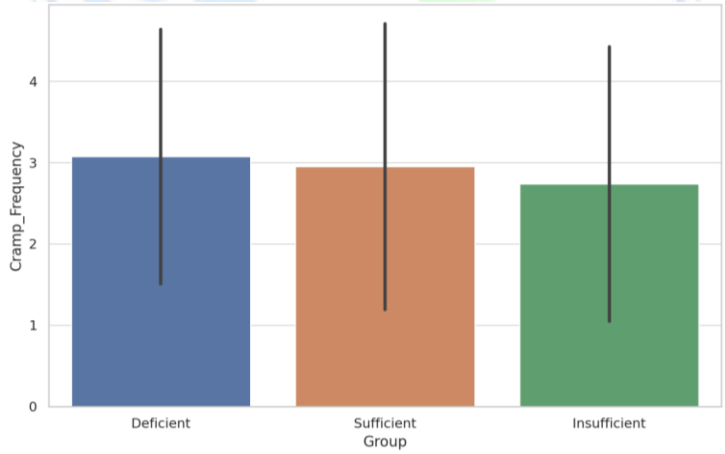

Figure 1: Average Cramp Frequency by Vitamin D Group

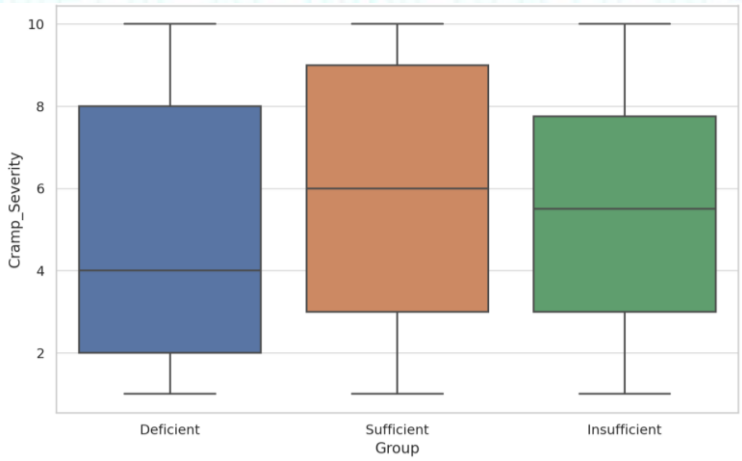

Figure 2: Cramp Severity Distribution by Vitamin D Group

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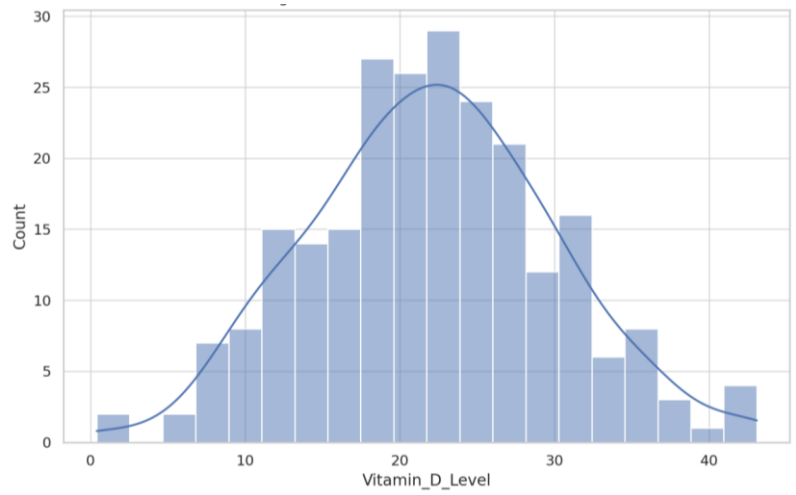

Figure 3: Distribution of Vitamin D Levels

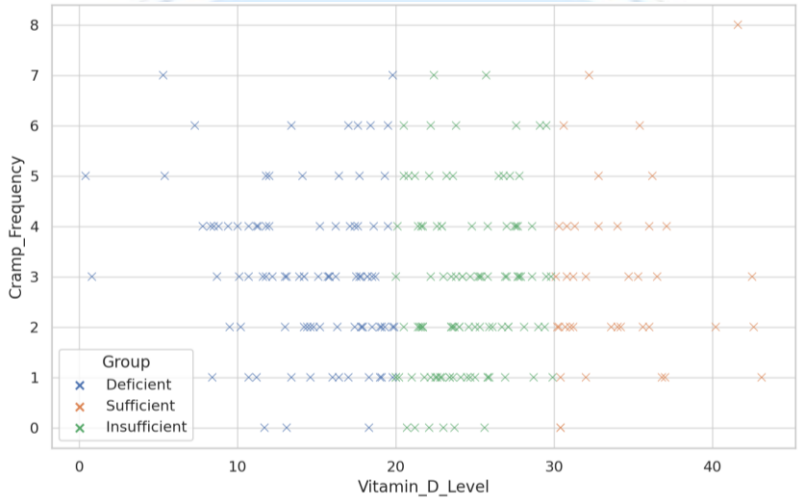

Figure 4: Vitamin D Level vs Cramp Frequency

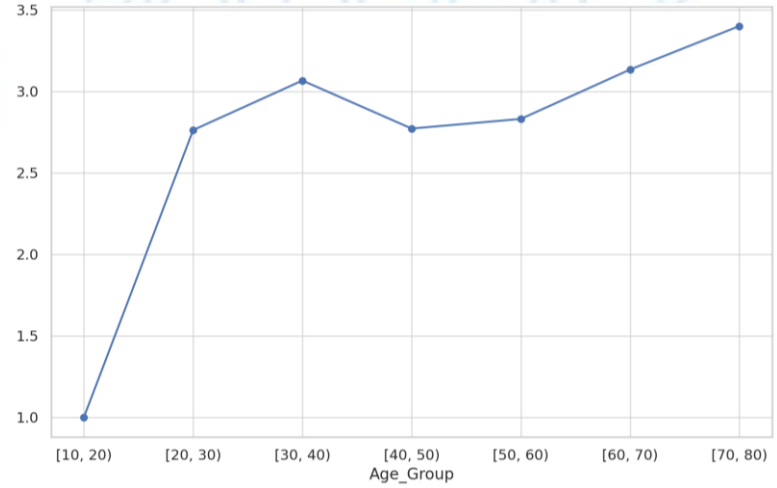

Figure 5: Mean Cramp Frequency Across Age Groups

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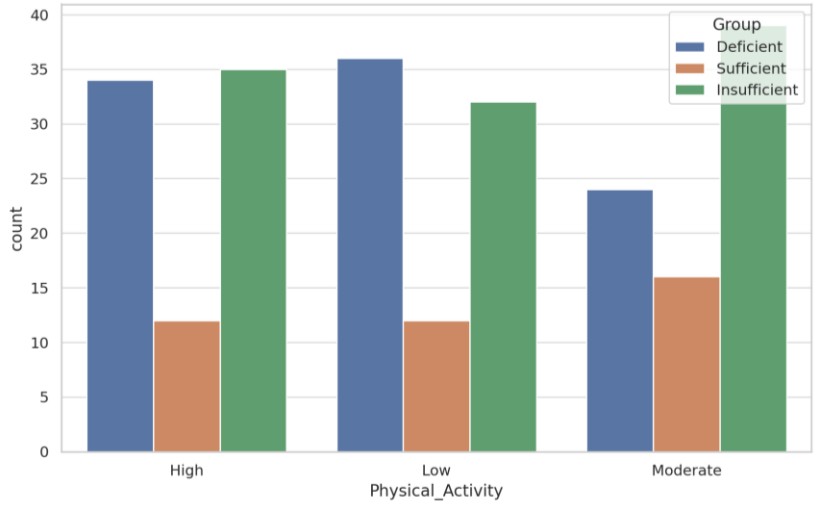

Figure 6: Physical Activity Levels Across Vitamin D Groups

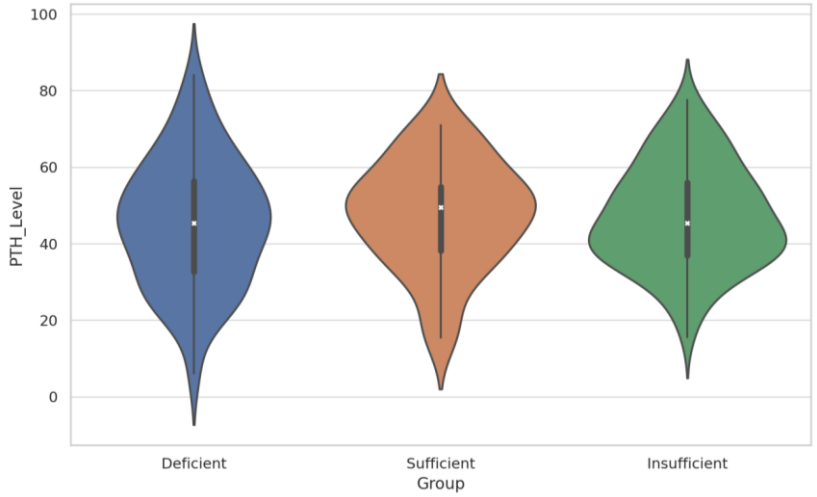

Figure 7: Distribution of PTH Levels by Group

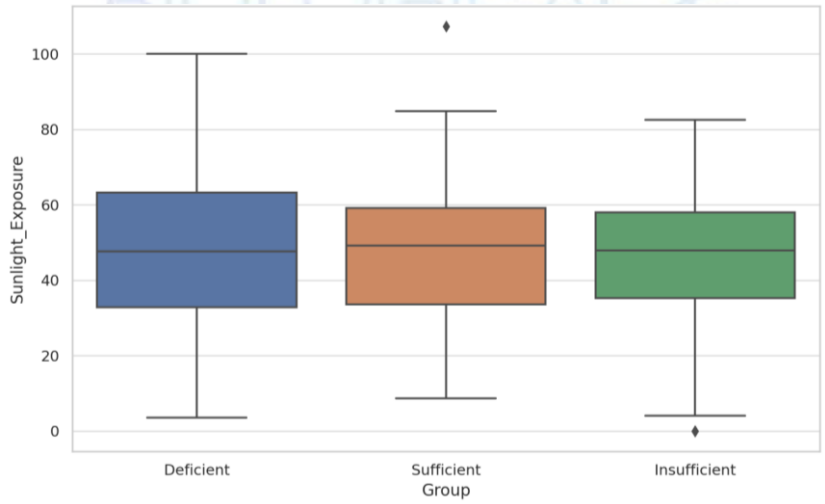

Figure 8: Sunlight Exposure by Vitamin D Group

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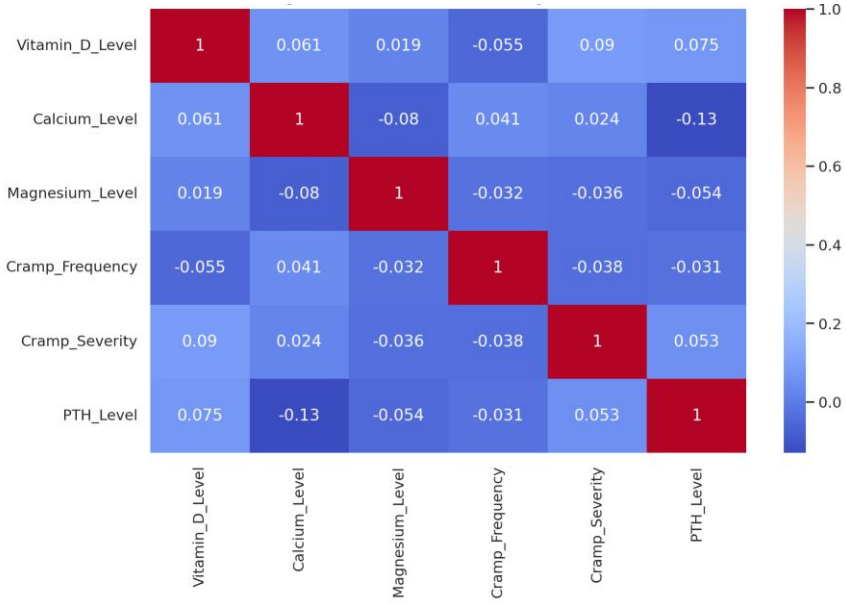

Figure 9: Correlation Matrix of Key Variables

3. DISCUSSION

The current study found that those with low vitamin D levels had higher and more serious cramps. As in previous studies, the results confirm that muscles benefit from vitamin D and that vitamin D deficiency may cause symptoms to get worse. A lack of vitamin D increases the chances of experiencing muscle cramps. If there is not enough vitamin D, it can result in reduced muscle contraction and relaxation to the extent that muscle cramps may occur. Vitamin D acts directly on nervous system cells because they carry receptors for vitamin D. The connection between vitamin D deficiency and muscle cramps is demonstrated by the abundant parathyroid hormone seen in the study. A reaction to not having enough vitamin D, secondary hyperparathyroidism may increase the readiness of nerves and muscles to fire and cause problems with calcium regulation.

A lack of vitamin D seems to make a person more likely to experience painful muscle cramps. In this study, the outcomes were similar to those from earlier reports that relate low vitamin D to extra muscle soreness (Grant et al., 2020). The association between lack of sunlight and exercise and muscle cramps highlights that vitamin D deficiency is a major factor affecting muscles. So, if someone boosts their vitamin D levels by being active outdoors or in sports, muscle cramps may be avoided. In the vitamin D deficient group, there were more muscle cramps among participants in the middle-aged category compared to participants in other groups. So, it is possible that the way muscles and vitamin D work with age increases the risk of cramps here. The results have significant effects on how care is provided to patients.

In cases where patients have constant muscle cramps, it helps to analyze their vitamin D and take action if it is lacking. Taking vitamin D and making changes to daily activity and sun exposure may help reduce the number and severity of muscle cramps. Additionally, since the study used a cross-sectional approach, it is not easy to prove a specific link between muscular cramps and low vitamin D. More research through long-term studies is needed to confirm this. When you get a muscle cramp, it leads to sudden and sharp pain, but normally the

symptoms go away naturally (Dijkstra et al., 2022). Even if they are often harmless, they may be very uncomfortable and keep people from working normally (Hu et al., 2022). Many factors such as time spent outside, eating a healthy diet, using supplements and daily habits, may alter a person's vitamin D level (Błasiak et al., 2020). So, taking vitamin D, going outside more and changing your routine can help you correct a vitamin D shortage.

4. CONCLUSION

This study finds that a higher frequency and intensity of muscle cramps in adults are connected to low levels of vitamin D in the blood. Those with low vitamin D (<20 ng/mL) experienced more and stronger cramps than both those with adequate or inadequate amounts. Looking at health markers and signs, deficient individuals had reduced calcium and magnesium and increased PTH. The findings suggest that through careful gene expression and calcium control in muscles, low levels of vitamin D cause muscle agitation and poor tissue relaxation. It was also found that the group with low vitamin D was represented by fewer people who were physically active and had little sunlight, evidence that these factors can be regulated to combat the issue as well as decrease the risk of muscle cramps. This link is also supported by findings that low vitamin D, but higher PTH, are connected to frequent and intense cramps. Even though the study cannot prove a direct cause-and-effect link, similar trends observed in different factors provide strong evidence for it. The significance of these findings is that monitoring vitamin D in patients with recurrent or unexplained muscle cramps, along with lower calcium or more PTH, may help in diagnosing vitamin D deficiency. They also encourage safe sunbeam time, taking vitamins and altering foods in communities that need extra benefits. To establish whether vitamin D helps, we should conduct research on blood levels, find the best blood levels for gaining relief and further check if vitamin D supplementation can reduce episodes and the intensity of cramps. Simply put, this study reveals new ways to address an unpleasant ailment that people commonly overlook.

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