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# Vitamin D-3 Status of the Adult Patients Treated under the Department of Orthopedic in a Tertiary Care Hospital, Dhaka, Bangladesh

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***Abstract:***
***Introduction:*** *The initial role of vitamin D-3 is the mineralization of bone by regulating osteoblast activity and facilitating the absorption of calcium and phosphorus from the intestines and calcium from the kidneys .Therefore vitamin D deficiency results osteomalacia in adults. Additionally, recent epidemiological studies have linked vitamin D deficiency to cardiovascular disease, dyslipidemias, diabetes mellitus, cancers, and auto immune diseases.*
***Objective:*** *The aim of this paper was to determine the vitamin D-3 status of adult patients attended at the department of Orthopedics in a tertiary care hospital.*
***Methods:*** *This was a descriptive type of cross-sectional study conducted at the department of Orthopedic in Central Police Hospital (CPH), Dhaka, Bangladesh during December, 2023 to May, 2024. A total of 100 adult orthopedic patients who were treated under the department of orthopedic with multidisciplinary orthopedic health issues aged 18 years and above were enrolled in this study. The collected data were analyzed using Statistical Package for Social Sciences (SPSS) software, version 23.0.*
***Results:*** *A total of 100 adult orthopedic patients were enrolled in this study. The mean age of the patients was 41.49±12.67 years. The majority of the patients were female 57(57%). The most frequent 96(96%) patients were from urban area. The most frequent orthopedic clinical presentation with the patients was observed low back pain (LBP) 42(42%). Among the patients, the most frequent 57(57%) were observed vitamin D-3 deficient, 23(23%) insufficient and 20(20%) sufficient. The most prevalent vitamin D-3 deficient age group was (28-37) years which includes 18(18%) of the deficient cases. The association between age, gender, residence and exposure to sunlight and vitamin D-3 status of the study patients was not observed statistically significant (P>0.05).*
***Conclusion:*** *This study investigated that 57(57%) patients were vitamin D-3 deficient, 23(23%) patients were insufficient and 20(20%) patients were sufficient. This study also investigated that among the orthopedic patients, the females are more vitamin D-3 deficient 35(35%) than the males (22%). Therefore, the deficient and insufficient patients immediately need to have vitamin D-3 supplementation to ensure quick recover from orthopedic health issue and healthy life.*
***Key words:*** *Vitamin-D-3, Status, Deficiency, Insufficiency, Sufficiency, Orthopedic, Tertiary, Hospital*

## I. INTRODUCTION

The initial role of vitamin D-3 is the mineralization of bone by regulating osteoblast activity and facilitating the absorption of calcium and phosphorus from the intestines and calcium from the kidneys [1].Therefore vitamin D deficiency results osteomalacia in adults [2]. Additionally, recent epidemiological studies have linked vitamin D deficiency to cardiovascular disease, dyslipidemias, diabetes mellitus, cancers, and auto immune diseases [3-7].,although causality has not yet been established. Thus, vitamin D deficiency effects not only musculoskeletal health, but potentially a wide range of acute and chronic medical conditions. It is therefore important to recognize and treat vitamin D deficiency promptly and effectively [8]. The major source of vitamin D for most human is exposure to sunlight. With exposure to ultraviolet (UV) radiation, vitamin D3 is synthesized in human skin via the photoisomerization of 7-dehydrocholesterol (7DHC) which

ultimately produces previtamin D3 [9]. Exposure to the amount of sunlight that causes a slight pinkness of the skin after 24 hours (1MED) is equivalent to ingesting approximately 20,000 IU of vitamin D [10]. Very few foods naturally contain vitamin D such as salmon, sardines, Tuna, Mackerel, shitake mushroom, hardboiled egg and foods that are fortified with vitamin D as like milk, cereal, orange juice, yogurt, and margarine. But those are inadequate to satisfy the requirement of vitamin D among children and adult [11].The American Academy of Pediatrics (AAP) and the Institute of Medicine (IOM), defines vitamin D deficiency, as a serum 25 - hydroxyvitamin D level of < 20 ng/ml [12]. Vitamin D deficiency causes rickets among children although rickets represents only the tip of the vitamin D deficiency iceberg. The vitamin D receptor is distributed in the osteoblasts, small intestine, and colon, activated T and B lymphocytes, b islet cells, mononuclear cells and most other organs in the human body including the brain, heart, skin, gonads, prostate, and breast [13]. In recent years, there has been lots of study regarding the influence of vitamin D on extra skeletal health, besides skeletal health. Hypovitaminosis D may be associated with diabetes mellitus [14] cancers, autoimmune diseases infectious diseases, multiple sclerosis and other cardiovascular diseases [15, 16]. In recent years, there has been lots of study regarding the influence of vitamin D on extra skeletal health, besides skeletal health. Hypovitaminosis D may be associated with diabetes mellitus, cancers, autoimmune diseases, infectious diseases, multiple sclerosis and other cardiovascular diseases [17]. Nowadays, vitamin D deficiency is a silent and neglected global public health issue. Almost one billion people in the world suffer from vitamin D deficiency or insufficiency [18]. There is a misconception that vitamin D deficiency is prevalent only in western countries, but in practical field it is totally reverse. Previously, it was assumed that hypovitaminosis D is less frequent in tropical countries, as cutaneous vitamin D synthesis is stimulated by exposure to sun. But, surprisingly 80% of the apparently healthy population is deficient in vitamin D. However, Vitamin D deficiency is currently recognized as a worldwide epidemic and its potential health implications have become the subject of significant interest and controversy. The aim of this paper was to determine the vitamin D-3 status of adult patients attended at the department of Orthopedics in a tertiary care hospital.

## II. OBJECTIVES

**General Objective**

To determine vitamin D-3 status of the patients treated under the department of orthopedic with multidisciplinary orthopedic health issues.

**Specific Objectives**

- To identify the socio-demographic characteristics of orthopedic patients treated under the department of orthopedic with multidisciplinary orthopedic health issues.
- To know the clinical diagnosis status of the study patients.
- To observe the overall vitamin D-3 status of the study patients.
- To determine vitamin D-3 status of the study patients according to their socio-demographic characteristics.

## III. METHODOLOGY

This was a descriptive type of cross-sectional study conducted at the department of Orthopedic in Central Police Hospital (CPH), Dhaka, Bangladesh during December, 2023 to May, 2024. The purpose, benefits and risks of this study were disclosed to the patients in local language. Then written informed consent was obtained from the patients. A purposive consecutive sampling technique was used and a total of 100 adult orthopedic patients who were treated under the department of orthopedic with multidisciplinary orthopedic health issues aged 18 years and above were enrolled in this study. Blood samples for laboratory measurements of serum 25 (OH) D were collected on patients' participation (4 ml), which were immediately transferred to the endocrinology laboratory. Serum 25 (OH) D was measured using a radioimmunoassay kit technique using the 12 well gamma Counter machine (STRATEC, Birkenfeld, Germany). Till the samples were not processed, they were stored at-20°C temperature after separating the serum. Vitamin D-3 deficiency was defined as values (<20 ng/mL), and followed by insufficiency (20-30 ng/mL), sufficiency (30-100 ng/mL) and toxicity (>100ng/mL) [12]. The data were collected through a Case Record Form (CRF). The collected data were cleaned, edited and entered into computer for analysis. The data were analyzed using Statistical Package for Social Sciences (SPSS) software, version 23.0. Descriptive statistical analysis were performed to determine the demographic characteristics of the study patients. Then Chi-square tests were performed to determine the association of vitamin D-3 level according to demographic characteristics of the study patients where P>0.05 considered as the level of significance. The results were presented as frequency and percentage in tables and charts. The inclusion and exclusion criteria of this study were as follows.

**Inclusion criteria**

1. Age ：18 years and above
2. Able to participate in the study
3. Willing to participate in the study

**Exclusion criteria**

1. Age: Below 18 years
2. Critically ill
3. Unwilling to participate in the study

## IV. RESULTS

**Table-1:** Baseline characteristics of the study patients (n=100).

| Age Category (years) | Frequency | Percent |
|---|---|---|
| 18-27 | 15 | 15 |
| 28-37 | 28 | 28 |
| 38-47 | 25 | 25 |
| 48-57 | 20 | 20 |
| 58-67 | 9 | 9 |
| 68-77 | 3 | 3 |
| Total | 100 | 100 |
| Mean age(years) | 41.49±12.67 | |
| Median | 50.5 | |
| Mode | 37 | |
| Range | 51 | |
| **Gender Distribution** | | |
| Male | 43 | 43 |
| Female | 57 | 57 |
| Total | 100 | 100 |
| **Residence Distribution** | | |
| Urban | 96 | 96 |
| Rural | 4 | 4 |
| Total | 100 | 100 |
| **Setting of the patients** | | |
| In patients enrolled | 15 | 15 |
| OPD Patients enrolled | 85 | 85 |
| **Daily exposed to sunlight (hour/day)** | | |
| <1 hour | 66 | 66 |
| >1hour | 34 | 34 |
| Total | 100 | 100 |

**Table 1** shows the distribution of baseline characteristics of the study. Among the study patients, the majority 28(28%) patients belonged to the group (28-37) years and followed 25(25%), (38-47) years, 20(20%), (48-57) years, 15(15%), (18-27) years and 9(9%), (58-67) years and 3(3%), (68-77) years. The mean age of the patients was 41.49±12.67 years and followed median 40.5 years and mode 37 years. The most frequent 57(57%) patients were female and 43(43%) were male. The maximum 96(96%) patients were from urban area and 4(4%)

patients were from rural area of Bangladesh. The maximum 85(85%) setting of the patients were OPD and 15(15%) were in patients. The maximum 66(66%) patients exposed to sunlight (<1hour) and 34(34%) patients exposed to sunlight (>1hour) per day.

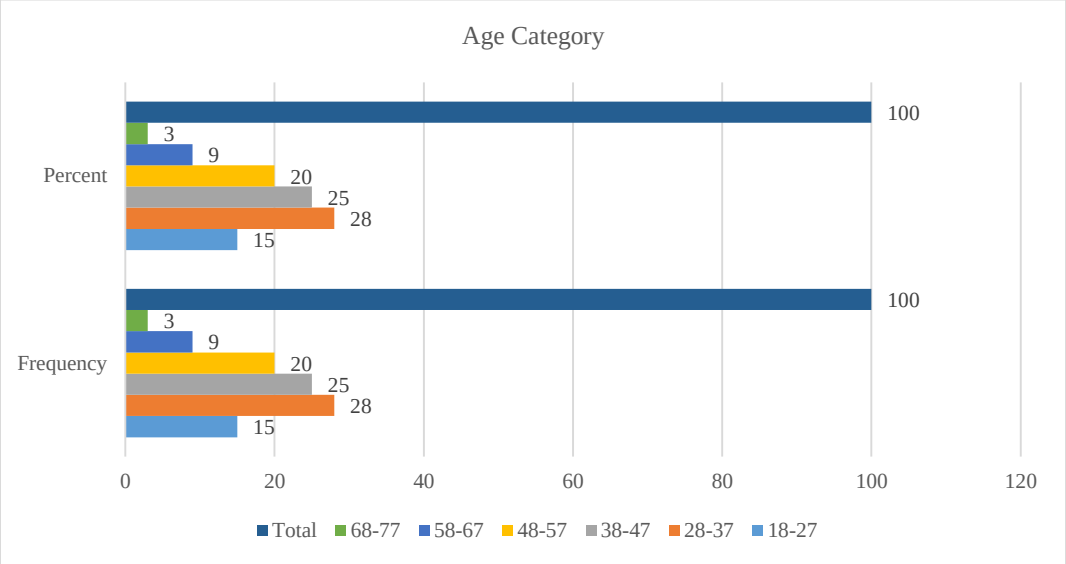


**Fig-1: Distribution of age category of the study patients (n=100)**

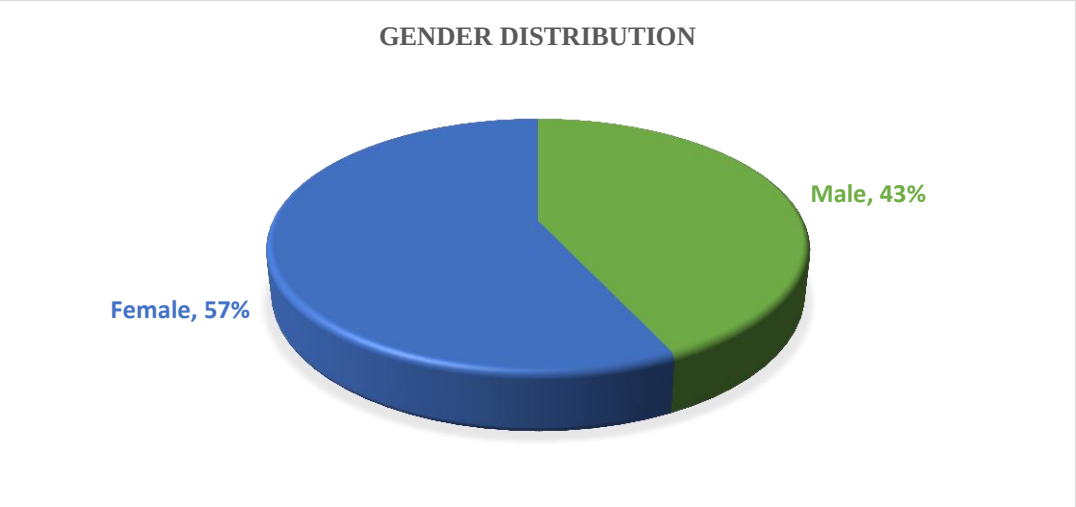


**Fig-2: Gender distribution of the study patients (n=100).**

**Table-2:** Distribution of clinical presentation observed with the study patients (n=100).

| Clinical presentation | Frequency | Percent |
|---|---|---|
| Low back pain (LBP) | 42 | 42 |
| Radial head fracture | 4 | 4 |
| Non- union left tibia with illizarov ring in situ | 10 | 10 |
| Osteoarthritis knee (Unilateral) | 9 | 9 |
| Osteoarthritis knee (Bilateral) | 11 | 11 |
| Ankle joint pain | 3 | 3 |
| Low back pain with prolapse lumbar intervertebral disc (PLID) | 17 | 17 |
| Anterior cruciate ligament (ACL) injury | 2 | 2 |
| Wrist joint pain | 2 | 2 |
| Total | 100 | 100 |

**Table 2** shows the distribution of clinical presentation observed with the study patients. Among the study patients, the most frequent 42(42%) parents suffered from low back pain (LBP) and followed 4(4%) radial head fracture, 10 (10%) non- union left tibia with illizarov ring in situ, 9(9%) osteoarthritis knee (unilateral), 11(11%) osteoarthritis knee (bilateral)3(3%) ankle joint pain, 17(17%) low back pain with prolapse lumbar intervertebral disc (PLID),2(2%) anterior cruciate ligament (ACL) injury and 2(2%) wrist joint pain.

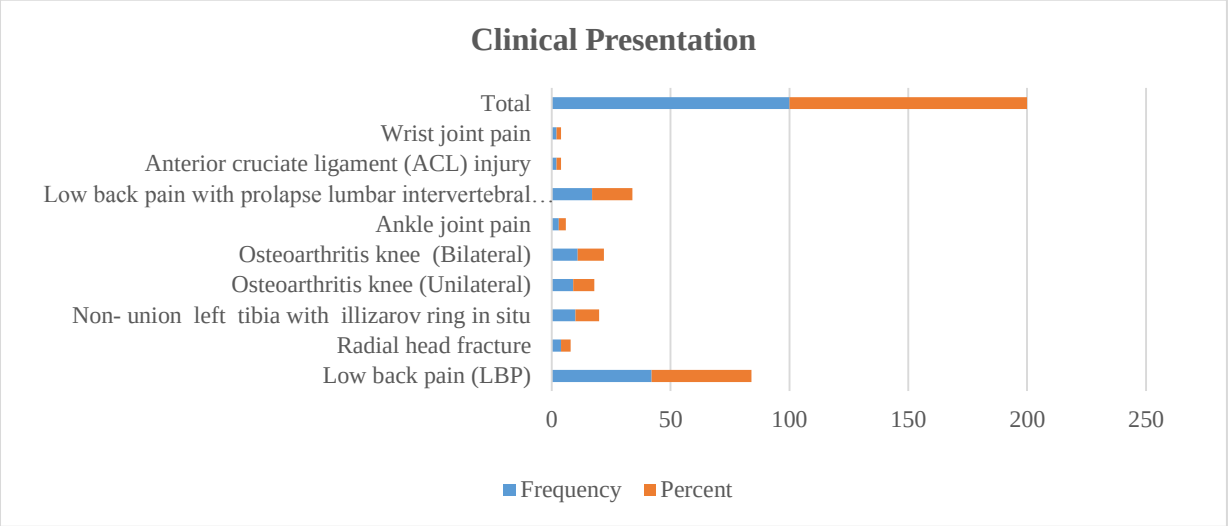


**Fig-3: Distribution of clinical presentation (n=100).**

**Table-3:** Distribution of observed vitamin D-3 status of the study patients (n=100).

| Variation of Vitamin D-3 status | Frequency | Percent |
|---|---|---|
| 1-20 ng/mL (Deficiency) | 57 | 57 |
| 20-30 ng/mL (Insufficiency) | 23 | 23 |
| 30-100 ng/mL(Sufficiency) | 20 | 20 |
| >100 ng/mL (Toxicity) | 0 | 0 |
| Total | 100 | 100 |
| Mean vitamin D-3 level(ng/mL) | 21.96 ±12.57 | |

**Table 3** shows the distribution of observed vitamin D-3 status of the study patients. The most frequent 57(57%) patients were observed to be vitamin D-3 deficiency (1-20 ng/mL) and followed 23(23%) insufficiency (20-30 ng/mL), and 20(20%) sufficiency (30-100 ng/mL). Mean vitamin D-3 level was observed 21.96 ±12.57 ng/mL.

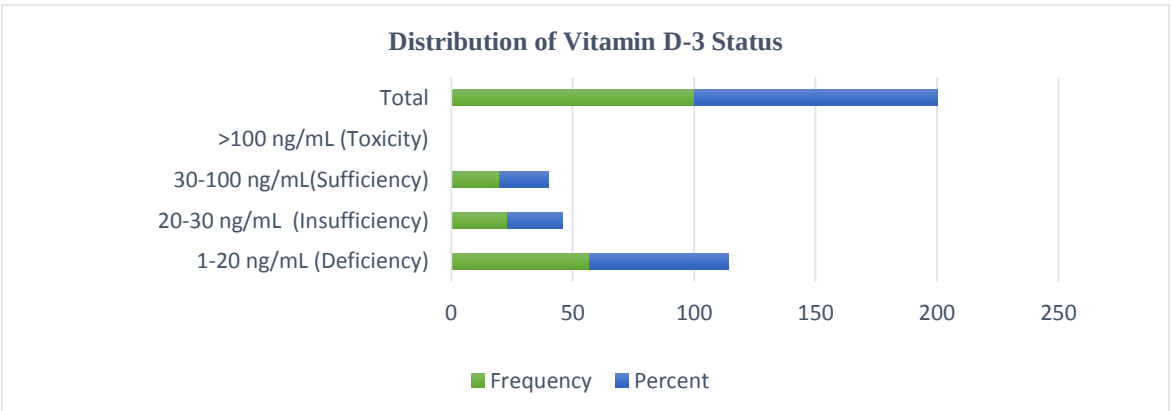


**Fig-4: Distribution of vitamin D-3 status of the study patients (n=100).**

**Table-4:** Distribution of observed vitamin D-3 status by age category the study patients (n=100).

| Age Category9years) | 1-20 ng/mL Deficiency N(%) | 20-30 ng/mL Insufficiency N(%) | 30-100 ng/mL Sufficiency N(%) | >100 ng/mL Toxicity (N%) | Total N(%) | p-value |
|---|---|---|---|---|---|---|
| 18-27 | 10(10) | 2(2) | 3(3) | 0(0) | 15(15) | 0.348 |
| 28-37 | 18(18) | 5(5) | 5(5) | 0(0) | 28(28) | |
| 38-47 | 15(15) | 5(5) | 5(5) | 0(0) | 25(25) | |
| 48-57 | 11(11) | 7(7) | 2(2) | 0(0) | 20(20) | |
| 58-67 | 3(3) | 393) | 3(3) | 0(0) | 9(9) | |
| 68-77 | 0(0) | 1(1) | 2(2) | 0(0) | 3(3) | |
| Total | 57(57%) | 23(23) | 20(20) | 0(0) | 100(100) | |

**Table-4** shows the distribution of vitamin D-3 level by age category of the study patients. The most frequent vitamin D-3 deficiency age group was observed (28-37) years which includes 18(18%) patients followed (48-57) years 7(7%) insufficiency, (38-47) years 5(5%) sufficiency. The relation between age category and vitamin D-3 level of the study patients was not statistically significant (P>0.05).

**Table-5:** Distribution of observed vitamin D-3 status by gender category of the study patients (n=100).

| Gender | Vitamin D-3 Status | | | | Total N(%) | p-value |
|---|---|---|---|---|---|---|
| | 1-20ng/mL Deficiency N(%) | 20-30 ng/mL Insufficiency N(%) | 30-10ng/mL Sufficiency N(%) | >100 ng/mL Toxicity N(%) | | |
| Male | 22(22) | 13913) | 8(8) | 0(0) | 43(43) | 0.268 |
| Female | 35935) | 10(10) | 12(12) | 0(0) | 57(57) | |
| Total | 57(57) | 23(23) | 20920) | 090) | 100(100) | |

**Table 5** shows the distribution of observed vitamin D-3 status by gender category of the study patients. Among the male adults, the distribution of vitamin D-3 level was being observed 22(22%) deficiency, 13(13%) insufficiency and 8(8%) sufficiency while among the female adults, the distribution of vitamin D-3 level was being observed 35(35%) deficiency, 10(10%) insufficiency and 12(12%) sufficiency and no toxicity was observed both in male and female adults. The relation between gender category and vitamin D-3 level of the study patients was not statistically significant (P>0.05).

**Table-6**: Distribution of observed vitamin D-3 status by residence category of the study patients (n=100).

| Residence | Vitamin D-3 Status | | | | Total N(%) | p-value |
|---|---|---|---|---|---|---|
| | 1-20 ng/mL Deficiency N(%) | 20-30 ng/mL Insufficiency N(%) | 30-100 ng/mL Sufficiency N(%) | >100 ng/mL Toxicity N(%) | | |
| Urban | 55(55%) | 23(23) | 18(18) | 0(0) | 96(96) | 0.238 |
| Rural | 2(2) | 0(0) | 2(2) | 0(0) | 4(4) | |
| Total | 57(57) | 23(23) | 20(20) | 0(0) | 100(100) | |

**Table 6** shows the distribution of observed vitamin D-3 status by residence category of the study patients. Among urban study patients vitamin D-3 status were being observed 55(55%) deficiency, 23(23%) insufficiency and 18(18%) sufficiency while in rural study patients, vitamin D-3 level status were being observed 2(2%) deficiency, 0(0%) insufficiency, 2(2%) sufficiency and no toxicity was observed. The relation between residence category and vitamin D-3 level of the study patients was not statistically significant (P>0.05).

**Table-7:** Distribution of observed vitamin D-3 status by exposure to sunlight category of the study patients (n=100).

| Sunlight exposure | Vitamin D-3 Status | | | | Total N(%) | P-value |
|---|---|---|---|---|---|---|
| | 1-20 ng/mL Deficiency N(%) | 20-30 ng/ml Insufficiency N(%) | 30-100 ng/ml Sufficiency N(%) | >100 ng/mL Toxicity N(%) | | |
| <1 hour | 37(37) | 15(15) | 14(14) | 0(0) | 66(66) | 0.914 |
| >1 hour | 20(20) | 8(8) | 6(6) | 0(0) | 34(34) | |
| Total | 57(57) | 23(23) | 20(20) | 0(0) | 100(100) | |

**Table 7** shows the distribution of observed vitamin D-3 status by exposure to sunlight category of the study patients,. The patients who exposed to sun light (<1hour) being observed to be 37(37%) deficiency, 15(15%) insufficiency and 14(14%) sufficiency while the patients who exposed to sunlight (>1hour) being observed to be 20(20%) deficiency, 8(8%) insufficiency and 6(6%) sufficiency and no toxicity was observed. The relation between exposure to sunlight category and vitamin D-3 level of the study patients was not statistically significant (P>0.05).

## V. DISCUSSION

This study observed that the most frequent age group of the study patients was (28-37) years which includes 28(28%) of the study patients and the mean age of the patients was 41.49±12.67 years with a median of 40.5 years and mode 37 years. The majority of the patients were female 57(57%) and majority of the patients' residence was urban area 96 (96%). The majority of the patients were from urban area 96(96%). The maximum 66(66%) patients exposed to sunlight (<1hour) and 34(34%) patients exposed to sunlight (>1hour) per day. These baseline characteristics of this present study are almost similar to another study conducted in Bangabandhu Sheikh Mujib Medical University (BSMMU) by Yadav A et al (2022). They observed the mean age of the patients was 37.57±12.23 years and male patients were 51.5% and female patients were 48.5%. The majority of the patients were from urban area 74.6%. Inadequate sunlight exposure was found 81.5% and adequate sunlight exposure was found 18.5 %( n=130) [19]. This present study observed the most frequent 42(42%) parents suffered from low back pain (LBP) and followed 4(4%) radial head fracture, 10 (10%) non-union left tibia with illizarov ring in situ, 9(9%) osteoarthritis knee (unilateral), 11(11%) osteoarthritis knee (bilateral)3(3%) ankle joint pain, 17(17%) low back pain with prolapse lumbar intervertebral disc (PLID),2(2%) anterior cruciate ligament (ACL) injury and 2(2%) wrist joint pain. Another study on vitamin D-3 status under orthopedic department reported the patients were screened as trauma, spine arthroplasty, fragility fracture, osteoporosis and nonunion [20]. This current study found that the most frequent 57(57%) patients had vitamin D-3 deficiency, 23(23%) had insufficiency, and 20(20%) sufficiency and mean vitamin D-3 level of the patients was 21.96 ±12.57 ng/mL. These findings of this present study are persistent with some other studies [21-23].This current study found that the most frequent vitamin D-3 deficiency age group was observed (28-37) years which includes 18(18%) patients followed (48-57) years 7(7%) insufficiency, (38-47) years 5(5%) sufficiency. Another study found variations in 25-OH-D levels were seen among the different age groups of the patients. Within the study population, the median value of 25-OH-D level in the group of patients 30 years and younger , in the 31–50 age group it was 19.20 ng/mL, in the 51–69 age group it was 18.00 ng/mL, and in the 70 years old and older age group it was 17.00 ng/mL.[24]. This present study found that the distribution of vitamin D-3 status among the male patients were 22(22%) deficiency, 13(13%) insufficiency and 8(8%) sufficiency while among the female patients were 35(35%) deficiency, 10(10%) insufficiency and 12(12%) sufficiency. These findings of this study prevailed that female dominant in vitamin D-3 deficient cases. This may be caused due to their limited exposure to the sunlight and limited habits of taking vitamin D-3 contained foods than that of their counterpart. This study also prevailed that the most frequent vitamin D-3 deficient cases 55(55%) urban population. This may be happened due to sedentary life style of the urban population. This study further observed that the study population who exposed to sunlight <1 hour/day were the most vitamin D-3 deficient 37(37%) whereas who exposed to sunlight >1 hour/day comparably less vitamin D-3 deficient 20(20%). Similar observation was also found in some other studies [25-27].Finally, the association between age, gender, residence and exposed to sunlight and vitamin D-3 status was not observed statistically significant in this present study may be due to limited sample size or other issues (P>0.05).

## VI. CONCLUSION

This study investigated that 57(57%) patients were vitamin D-3 deficient, 23(23%) patients were insufficient and 20(20%) patients were sufficient. This study also investigated that among the orthopedic patients, the females are more vitamin D-3 deficient 35(35%) than the males (22%). Therefore, the deficient and insufficient patients immediately need to have vitamin D-3 supplementation to ensure quick recover from orthopedic health issue and healthy life.

### LIMITATIONS OF THE STUDY

This was a single center study over a short study period with a purposive limited sample size. Therefore, the results of this study may not represent the whole country.

### RECOMMENDATIONS

To justify the results of this study, a multicenter study is recommended with an adequate sample size over a long study period on a national scale.

**Conflict of interest:** None declared
**Funding:** Self

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