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# The Level of Vitamin D and the Prevalence of Various Deficiencies Among the Urban Population

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**Abstract:** In recent years, interest in determining vitamin D levels has been increasing both in medical practice and among the general population. This is primarily associated with the well-established role of vitamin D in numerous biochemical and metabolic processes in the human body. At the same time, studies have demonstrated that vitamin D deficiency directly contributes to the development of a wide range of diseases and influences their specific clinical course. According to many researchers, the main reasons for this include global environmental changes, alterations in lifestyle patterns, increased consumption of fast food and preservatives, and the growing prevalence of digestive system disorders as well as other somatic diseases [1,7].

**Keywords:** chronic pancreatitis, vitamin D.

Under physiological conditions, the primary source of vitamin D in serum is cholecalciferol synthesized in the skin under the influence of ultraviolet (UV) radiation, accounting for approximately 90%, whereas dietary ergocalciferol contributes around 10% [3,8]. These forms are transported via the bloodstream to the liver bound to lipoproteins or vitamin D–binding protein, where they are converted into metabolically stable 25-hydroxyvitamin D [25(OH)D] under the action of the mitochondrial cytochrome enzyme CYP27A1 (25-hydroxylase). Subsequently, 25(OH)D is carried by the blood to the kidneys, where, under the action of microsomal cytochrome enzymes CYP2R1 and CYP27B1 (1α-hydroxylase), the active metabolite 1α,25-dihydroxyvitamin D3 [1α,25(OH)2D3] is formed [5,6]. Its main target cells include enterocytes, renal tubular epithelial cells, and osteoblasts, and it plays a crucial role in maintaining calcium homeostasis [6]. The immunomodulatory effects of vitamin D are associated with indirect activation of the cellular component of the immune system, as well as regulation of cell proliferation and differentiation [2].

## Study objective

To assess the serum level of 25-hydroxyvitamin D [25(OH)D] among the population of Tashkent city.

## Materials and methods

In our study, serum 25(OH)D levels were determined in residents of Tashkent city. A total of 144 relatively healthy individuals aged 1 to 76 years were examined, as well as 20 pregnant women with physiologically progressing pregnancy in the second trimester. The analysis was performed according to sex (35 males and 109 females) and age groups.

Age stratification was carried out in accordance with WHO recommendations as follows: 6 preschool children, 5 kindergarten-age children, 8 primary school–age children, 6 secondary school–age children, 10 adolescents, 36 young adults, 61 middle-aged adults, and 14 elderly individuals. The obtained results were interpreted based on expert recommendations [4].

Vitamin D status was classified as follows:

- **sufficient level:** >30 ng/mL (>75 nmol/L);
- **insufficiency:** 20–30 ng/mL (50–75 nmol/L);
- **deficiency:** 10–20 ng/mL (<50 nmol/L);
- **severe deficiency:** <10 ng/mL (<25 nmol/L).

## Results

The findings demonstrated that the mean serum 25(OH)D concentration in the general population of Tashkent was 18.57 ± 0.93 ng/mL However, there was a wide variability in vitamin D levels among the participants (table 1).

**Table 1 Serum 25(OH)D levels and the prevalence of different degrees of vitamin D3 deficiency among the population of Tashkent city**

| Groups | Serum 25(OH)D, ng/mL | Prevalence of vitamin D3 status, % | | | |
|---|---|---|---|---|---|
| | | Sufficient | Insufficiency | Deficiency | Severe deficiency |
| **Total population, n=144** | 18.57 ± 0.93 | 13.9 | 21.5 | 55.6 | 9.0 |
| **By sex:** | | | | | |
| Males, n=35 | 16.97 ± 1.58 | 11.4 | 17.1 | 62.9 | 8.6 |
| Females, n=109 | 18.95 ± 1.13 | 14.7 | 22.9 | 53.2 | 9.2 |
| **By age:** | | | | | |
| Preschool age, n=6 | 32.42 ± 6.59 | 33.3 | 66.7 | 0.0 | 0.0 |
| Kindergarten age, n=5 | 28.42 ± 4.75 | 40.0 | 40.0 | 20.0 | 0.0 |
| Primary school age, n=8 | 17.55 ± 3.91 | 25.0 | 12.5 | 50.0 | 12.5 |
| Secondary school age, n=6 | 23.94 ± 3.16 | 66.7 | 33.3 | 0.0 | 0.0 |
| Adolescents, n=20 | 20.28 ± 3.37 | 20.0 | 20.0 | 50.0 | 10.0 |
| Young adults, n=36 | 14.85 ± 1.37 | 2.9 | 11.8 | 76.5 | 8.8 |
| Middle-aged adults, n=61 | 17.86 ± 1.56 | 14.7 | 16.5 | 59.0 | 9.8 |
| Elderly, n=14 | 18.62 ± 2.68 | 14.3 | 28.6 | 42.8 | 14.3 |
| Physiological pregnancy (2nd trimester), n=20 | 24.14 ± 3.17 | 35.0 | 25.0 | 20.0 | 20.0 |

Therefore, all examined individuals were classified according to their vitamin D status. The analysis demonstrated that only 13.9% of the population had sufficient vitamin D levels (>30 ng/mL). Vitamin D insufficiency (20–30 ng/mL) was identified in 21.5% of participants, whereas vitamin D deficiency (10–20 ng/mL) was observed in 55.6%. Severe deficiency (<10 ng/mL) was detected in 9.0% of the population. Thus, more than half of the residents of Tashkent city were found to have 25(OH)D deficiency.

When serum 25(OH)D levels were analyzed by sex in the general population, the mean concentration was 16.97 ± 1.58 ng/mL in males and 18.95 ± 1.13 ng/mL in females, indicating slightly lower levels in males. The distribution of vitamin D status by sex was as follows: sufficient levels were observed in 11.4% of males and 14.7% of females; insufficiency in 17.1% and 22.9%, respectively; deficiency in 62.9% and 53.2%; and severe deficiency in 8.6% of males and 9.2% of females. These findings suggest that vitamin D deficiency was more common among males; however, the differences were not statistically significant.

An age-stratified analysis of serum 25(OH)D levels among the population of Tashkent showed that children of preschool age (early childhood period) had the highest mean serum 25(OH)D concentration, reaching 32.42 ± 6.59 ng/mL. In our opinion, this may be related to vitamin D intake through breast milk, as mothers during this period often take multivitamin and multi-micronutrient

supplements. This assumption is supported by the fact that 33.3% of children in this group had sufficient vitamin D levels, whereas 66.7% had insufficiency.

In children of kindergarten age, the mean serum 25(OH)D level was 28.42 ± 4.75 ng/mL. Within this group, vitamin D levels were sufficient in 40% of children, insufficiency was found in 40%, and deficiency was detected in 20%.

In the group of primary school–age children, a statistically significant decline in serum 25(OH)D levels was observed. The mean concentration was 17.55 ± 3.91 ng/mL, and 25% of children had sufficient vitamin D levels, 12.5% had insufficiency, 50% had deficiency, and the remaining 12.5% demonstrated severe deficiency.

Among secondary school–age children, the mean serum 25(OH)D concentration was 23.94 ± 3.16 ng/mL. In this group, vitamin D insufficiency was identified in two-thirds of participants, whereas one-third had vitamin D deficiency.

In adolescents, the mean serum 25(OH)D level was 20.28 ± 3.37 ng/mL. In this age group, 20% of individuals had sufficient vitamin D levels, 20% had insufficiency, 50% had deficiency, and 10% had severe deficiency.

It should be noted that the adult age period is conventionally divided into two stages (first and second). In the present study, individuals in the first stage of adulthood demonstrated a mean serum 25(OH)D concentration of 14.85 ± 1.37 ng/mL ($P < 0.01$). Only 2.9% had sufficient vitamin D levels, whereas 11.8% had insufficiency, 76.5% had deficiency, and 8.8% had severe deficiency.

In individuals in the second stage of middle age, serum 25(OH)D levels remained low, with a mean concentration of 17.86 ± 1.56 ng/mL ($P < 0.001$). In this group, 14.7% had sufficient vitamin D levels, 16.4% had insufficiency, 59.0% had deficiency, and 9.8% had severe deficiency.

The lowest vitamin D status was observed in the elderly group, where the mean serum 25(OH)D concentration was 18.32 ± 2.68 ng/mL ($P < 0.01$). In this age group, 14.3% of participants had sufficient vitamin D levels, 28.6% had insufficiency, 42.8% had deficiency, and 14.3% had severe deficiency.

In women with physiologically progressing pregnancy in the second trimester, the mean serum 25(OH)D level was 24.14 ± 3.17 ng/mL ($P < 0.01$). In this group, 35% of pregnant women had sufficient vitamin D levels, 25% had insufficiency, 20% had deficiency, and 20% had severe deficiency.

According to the obtained results, vitamin D insufficiency or deficiency was detected across all examined groups. In our opinion, these changes may be associated with several factors, including lifestyle characteristics, dietary habits, and an undiagnosed malabsorption syndrome. In particular, the diet in our region is characterized by a high intake of carbohydrates, low consumption of fish and dairy products, and other nutritional imbalances. Despite sufficient sunlight throughout all seasons, the majority of the population wear long and covered clothing, which may reduce cutaneous cholecalciferol synthesis, as this pathway contributes the major proportion of circulating vitamin D.

Higher serum 25(OH)D levels observed in preschool children, kindergarten-age children, and pregnant women may be related to the prophylactic use of multivitamin preparations. The decrease in serum 25(OH)D levels in primary school–age children, in our view, may be explained by the beginning of the school period, associated stress factors, reduced compensatory capacity, and an increased demand for vitamins.

According to WHO recommendations, screening for vitamin D deficiency should be performed only in individuals with risk factors for its development [2]. Other authors suggest that serum 25(OH)D levels should range between 30–60 ng/mL (75–150 nmol/L). In our opinion, continuous monitoring of serum 25(OH)D in the population of our region is necessary, since our area belongs to territories with a high risk of vitamin D deficiency, and the association of vitamin D deficiency with numerous pathological conditions has been well documented [3].

## Conclusion

Thus, the results of the present study indicate that serum 25(OH)D levels in the population of Tashkent city are below the reference range and demonstrate marked interindividual variability. No significant differences were observed between sexes, and vitamin D levels were reduced in women during the second trimester of physiological pregnancy. Serum 25(OH)D levels varied across age groups. While concentrations in early childhood and childhood periods were close to normal values, they subsequently decreased and were significantly lower particularly in adolescents and adults.

Overall, serum 25(OH)D levels in the population of Tashkent were heterogeneous: 13.9% of individuals had sufficient levels, 21.5% had insufficiency, 55.6% had deficiency, and 9.0% had severe deficiency. No association with sex was identified. Higher serum 25(OH)D levels in preschool and kindergarten-age children, as well as in pregnant women, may be linked to prophylactic intake of multivitamin supplements. The decline in primary school–age children may be associated with the onset of schooling, stress-related factors, decreased compensatory capacity, and an increased requirement for vitamins. Significantly low serum 25(OH)D levels were observed especially in adolescents and adults. In our opinion, these alterations may also be related to lifestyle factors, dietary characteristics, and a possible undiagnosed malabsorption syndrome.

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