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Research Article

Comparative Study of Serum Vitamin D in the Urban and Rural Adult Population of Larkana District

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ABSTRACT

Vitamin D deficiency is a global phenomenon and a significant risk factor for various metabolic disorders. The current investigation emphasizes the notable disparities in serum vitamin D concentrations and lipid profiles between adult populations in urban and rural settings. A total of 264 individuals were chosen. Blood samples were collected and serum vitamin D levels and parameters assessed using automated enzymatic colorimetric techniques, all according to standardized procedures. Information on demographic traits, family history, physical activity, and sun exposure was gathered using structured questionnaires. The present findings showed that the BMI value in the rural area ranged from 11.07 to 47.34, with an average of 29.43 and a standard deviation of 9.05. The rural region presents a more dependable range of BMI values. The average BMI value was 29.43, which is somewhat lower than that of the urban area. The mean vitamin D score for the urban group was 18.39, significantly lower than that of the rural group. People living in urban areas tended to indicate that they engaged in less physical activity. Physical activity levels of urban and rural participants differed significantly with respect to Vitamin D, indicated by a P-value of less than 0.001. Vitamin deficiency or insufficiency affects most individuals across both rural and urban settings, irrespective of age, with those aged 31 to 50 being the most impacted. None show signs of vitamin intoxication, and only a small number of individuals have adequate vitamin levels. Pointing out the necessity of enhanced understanding of nutrition and possible supplements, particularly among younger and middle-aged individuals. The means of the age groups do not differ statistically significantly, as all p-values exceed 0.05. Even though the Age 31–50 group exhibits greater variance, the central tendencies of the distributions. The findings indicate that young individuals in rural areas exhibit a significantly higher level of physical activity compared to those in urban areas. This could be a reflection of how the two environments differ in terms of infrastructure, environmental elements, lifestyle, and work needs.

Keywords: Serum Vitamin D, Urban and Rural Adult Population, Metabolic Disorders.

INTRODUCTION

Vitamin D, a fat-soluble vitamin, plays crucial biological roles in the human body. Although the most significant source of vitamin D is exposure to sunlight (Lu, Q et al., 2024). 7-dehydrocholesterol is found in the skin. Vitamin D is formed after the absorption of ultraviolet rays, with provitamin D3 playing a crucial role. It is converted to previtamin D3 through hydroxylation by hydroxylase enzymes, specifically involving 25(OH)D. With the assistance of hydroxylases enzymes found in the liver and kidneys, this is converted into 1,25-dihydroxyvitamin D3. Vitamin D plays a crucial role in bone metabolism and calcium regulation. (Ahmed, L. H et al., 2020). Vitamin D is absorbed from the intestine and metabolized, playing a crucial role in reducing triacylglycerol levels and increasing blood calcium levels (Alhamed, M. S et al.,2024). The patient's low vitamin D levels, attributed to lack and inadequacy, have been documented in several studies (Amrein, K et al., 2020; Aoun, A et al., 2020). Vitamin D is believed to enhance immune system function, exert anti-inflammatory effects, suppress the renin-angiotensin system, and reduce insulin resistance. There are also reports of a suggestive connection between vitamin D and heart disease (cardiovascular). Since deficiency or insufficiency influences the lipid profile, which includes serum cholesterol, triacylglycerol, low-density lipoproteins, and high-density lipoproteins (Al Ghadeer, H. A *et al.,*2022; Contreras-Bolívar, V *et al.,* 2021). Vitamin D abnormalities can be associated with the lipid profile, such as elevated levels of Low-Density Lipoprotein Cholesterol (LDL.C), Triacylglycerol (TG), and total Cholesterol (T.C). The risk of these abnormalities is significantly associated with cardiovascular morbidity and heart diseases (Morvaridzadeh, M et al., 2021). In children, a lack of vitamin D shows up as fractures and rickets, while in adults, it manifests as osteomalacia. It has also been noted that even a mild vitamin D deficiency is linked to long-term skeletal consequences, including increased bone turnover, heightened bone loss, secondary hyperparathyroidism, and elevated fracture risk (Amphansap, T et al., 2021; Goel, S. (2020). Over the past ten years, twenty-five -OH (D) has been identified as crucial for various health functions, including immunity, reproduction, and the muscular and skeletal systems, across all age groups (Iyer, S, 2019). It has already been observed that vitamin D status is strongly linked to the risk of chronic diseases (Rebelos, E. et al. 2024).

MATERIAL AND METHODS

3.1: STUDY TYPE

Cross sectional study

3.2: STUDY DESIGN

The purpose of this study was to compare the levels of Vitamin D and Lipid Profile in urban and rural men and women. Prior to commencing the study, written consent was secured from the subjects, and approvals were obtained from the scientific review committee, institutional review board, and the Board of Advance Studies and Research.

3.3: STUDY AREA

Healthy Population urban and rural population of district Larkana, Sindh, Pakistan was the study area for this study.

3.4: STUDY POPULATION

Based on the guidelines provided in the inclusion and exclusion criteria, 264 subjects were chosen for the study and split into two groups. From the healthy adult urban population, 132 samples were gathered. 132 samples chosen from rural populations.

3.5: PERSONAL/ DEMOGRAPHIC INFORMATION OF THE SUBJECTS.

As per the questionnaire crafted according to certain guidelines, the information of each individual subject was documented following the acquisition of informed consent. The participants received a briefing regarding the potential advantages and disadvantages resulting from the study. Particular importance was placed on the details about all potential risk factors such as blood pressure, hypertension, and anxiety. A comprehensive clinical examination was performed, which included measuring blood pressure and calculating BMI.

3.6: BLOOD SAMPLE COLLECTION

The blood sample was taken from the antecubital vein using a plastic disposable syringe. A volume of 5 ml blood was placed in a Gel Tube with a clot activator and was allowed to sit at room temperature for 5 to 10 minutes so that a clot could form. The clot was removed, and serum was obtained through centrifugation for 5 minutes at 3000 to 4000 rpm at room temperature for 5 to 10 minutes. Following this procedure, the serum was kept in a referigrator until analysis. On the samples, specific numbers of subjects were also labeled.

3.6.1: ESTIMATION OF VITAMIN D

Stored serum samples were utilized for the assessment of vitamin D. Serum was collected, and before analysis, the sample was allowed to reach room temperature. It was then analyzed using chemiluminescence (Michael F. Holick, 2007).

3.7: STATISTICAL ANALYSIS

Data was analyzed through Statistical package by (SPSS-21). The data is presented using means, standard deviations, frequencies, percentages, and correlations of vitamin D levels in both urban and rural populations. Potential confounders are limited by the sample selection criteria established during the design phase. The variable stratification included name, family, address, weight, height, duration of sun exposure, literacy, socio-economic status, and BMI. Results generated through analysis are presented in tables, bar graphs, pie charts and correlation tables/ graphs.

RESULT

In the subsequent chapter are Larkana district was chosen for the present study, which was carried out in both urban and rural areas of the district. Both males and females are included for study. A variety of data was collected, including name, sex, marital status, education level, occupation, age, weight, height, vitamin

D level, BMI, HDL, LDL, cholesterol, TAG, and non-HDL cholesterol.

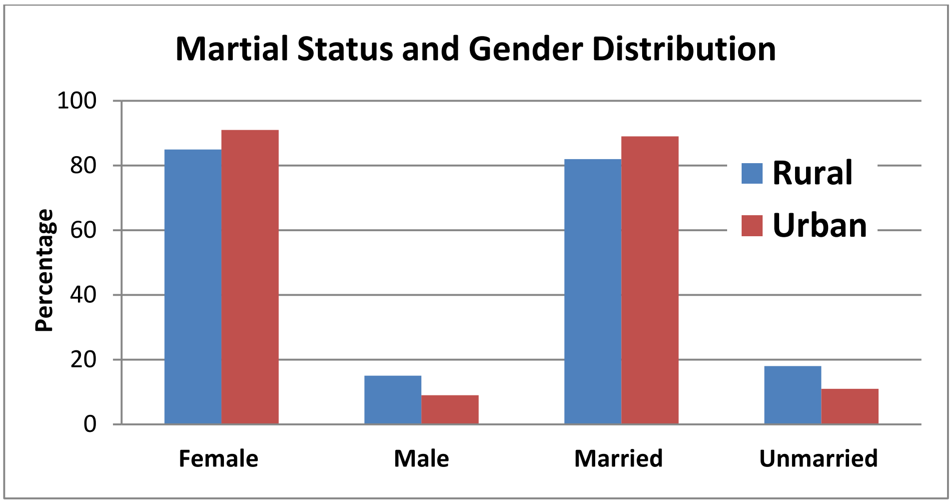

Figure.1: Martial Status and Gender Distribution

It was discovered that among the rural population, 82% of individuals were married and 18% were unmarried. This indicates that 85% of people were married, while only 15% were not. The distribution is significant due to the impact marital status can have on psychological well-being and various health behaviors. The data on the urban population indicated that a significant majority, 89%, were married, while only 11% were unmarried. This shows that the study sample had a considerable gender imbalance, with females comprising 91% of participants and males only 9%. This imbalance might mirror the characteristics of the condition or disease under investigation, as some health issues may disproportionately impact females, or there could be other factors contributing to the gender imbalance among participants.

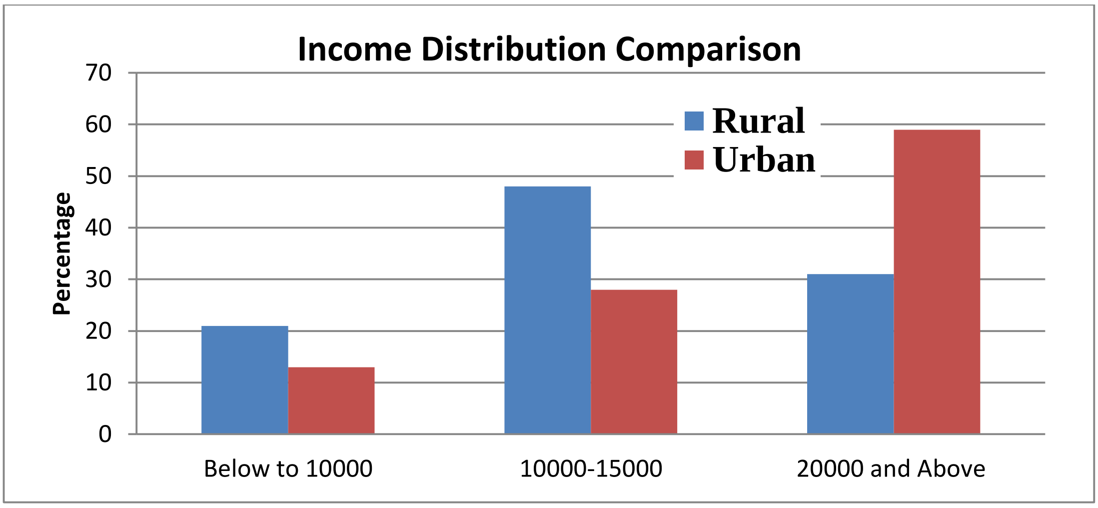

Figure.2: Income Distribution Comparison: Rural vs. Urban Population

There are more low-income individuals in rural areas, with 21 people earning under 10,000 compared to 13 in urban areas. The majority of individuals in rural areas (48) belong to the 10,000-15,000 income bracket, whereas urban areas contain only 28 individuals in this category. Individuals with higher incomes (earning 20,000 or more) are more commonly found in urban areas (59) than in rural areas (31), highlighting an income disparity. Urban areas offer more financial prospects, while rural areas mainly rely on lower-paying jobs, highlighting the need for economic advancement and job expansion in rural regions. The income data was segmented into three categories: 5000, 10000-15000, and above 20000 rupees. The majority of individuals fall into the low-income range from 10000 to 15000, with only a few individuals earning above 20000 rupees.

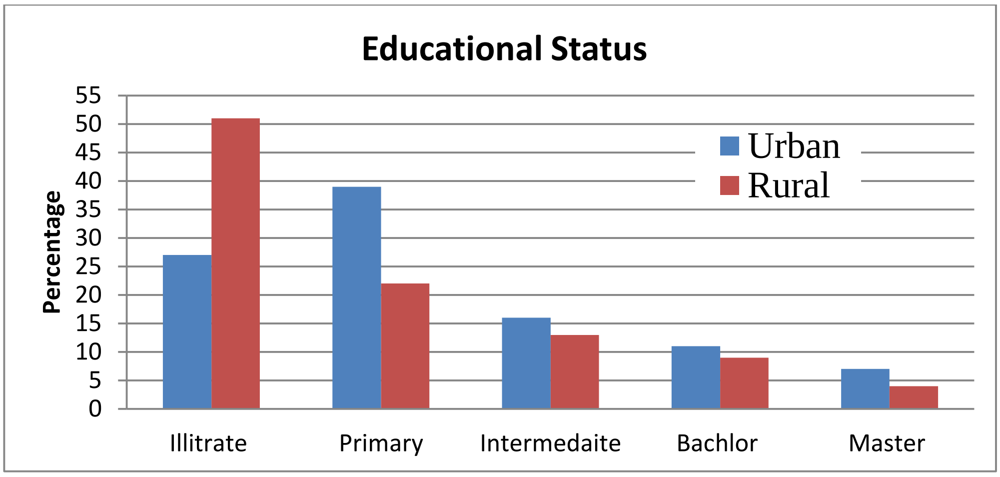

Figure.3: Comparison of Educational Attainment in Urban and Rural Populations

The data specifies the count of individuals categorized by their educational qualifications within two separate groups: Rural and Urban populations. It shows a significant difference in educational attainment between urban and rural regions. Illiteracy rates are higher and achievements in higher education are lower among the rural population, with 51 illiterate individuals found in rural areas versus 27 in urban areas, indicating limited access to educational resources in the countryside. Factors that may play a role include the lack of schools, insufficient infrastructure, financial challenges, and cultural beliefs affecting education in rural regions. In urban areas, the number of individuals who have completed primary education is greater (39), compared to only 22 in rural areas. Nonetheless, urban areas maintain a marginal edge in intermediate (16 vs. 13), bachelor's (11 vs. 9), and master's (7 vs. 4) degree attainment. The figures for individuals earning bachelor's and master's degrees remain considerably low across both categories, but rural areas show even less representation.

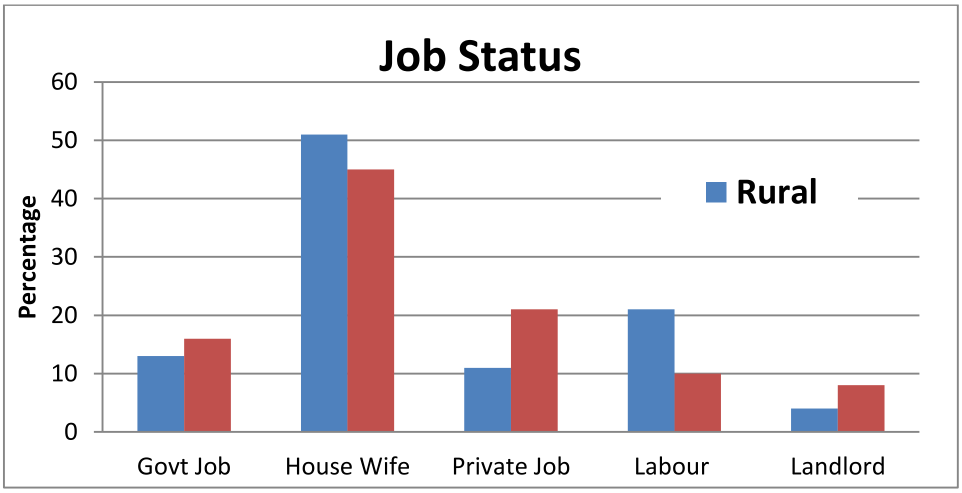

Figure.4: Occupational Distribution Trends

The data shows the distribution of people according to their jobs, indicating that just 13% of the rural population identified as government employees, compared to 16% of the urban population in government positions. The educational achievement gap between urban and rural populations is significant. In rural areas, housewives make up a significant portion at 51%, compared to 45% in urban regions, indicating that educational opportunities in rural settings are limited. Factors that may contribute include a lack of schools, poor infrastructure, financial barriers, and cultural norms that affect education in these regions. In urban areas, the percentage of government employees is 13%, whereas in rural areas it is 16%.

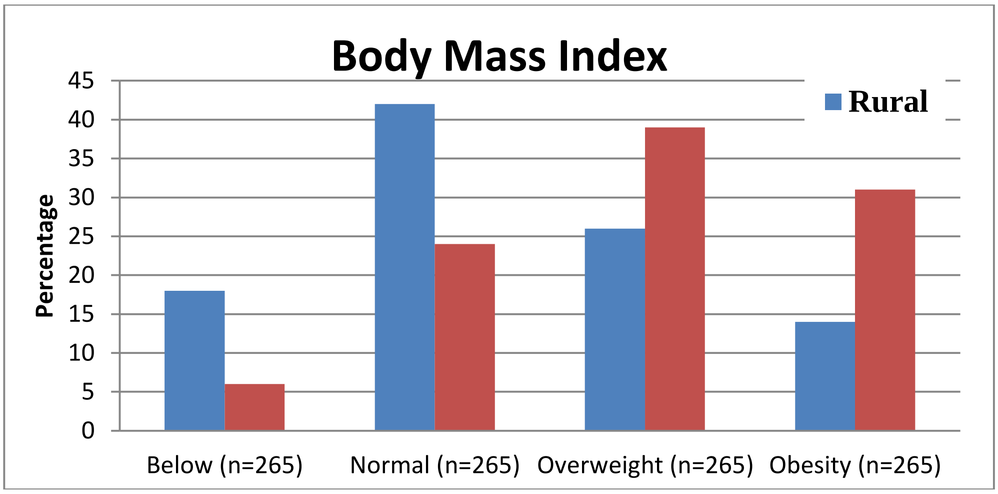

Figure.5: Body Mass Index trends in rural and urban population

The illustration shows how body weight is distributed among rural and urban populations (n=265). Rural populations show a greater prevalence of underweight individuals (18 versus 6 in urban areas), suggesting possible nutritional deficiencies. Normal weight is more prevalent in rural regions (42 compared to 24 in urban areas), indicating a healthier weight balance. Urban populations exhibit a higher prevalence of overweight individuals (39 vs. 26) and a greater number of obesity cases (31 vs. 14). These trends could originate from a lack of physical activity and unhealthy eating habits. As a result, urban populations face an increased risk of obesity-related health problems, while rural populations may gain from better nutrition education.

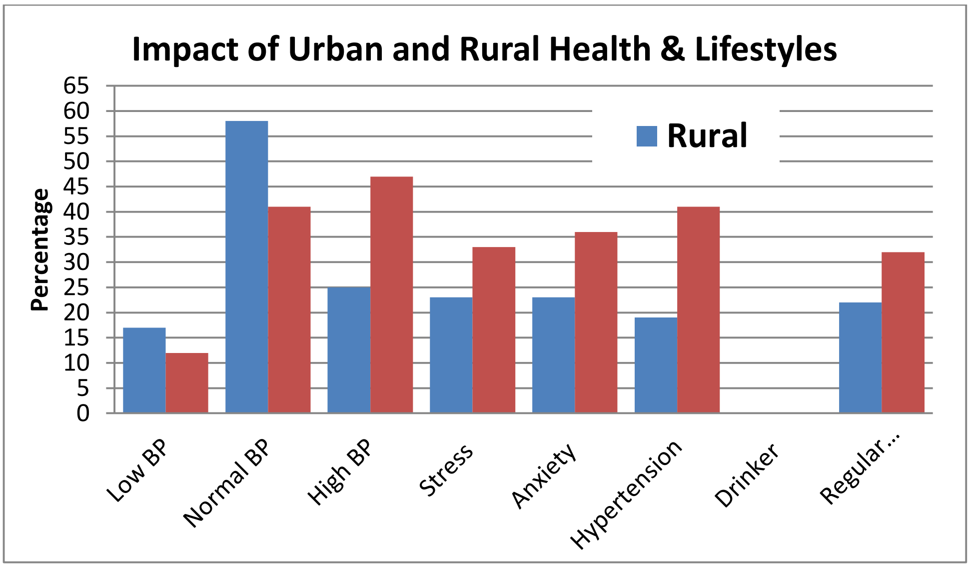

Figure.6: Impact of urban and rural lifestyles on health

The table shows a comparison of various health indicators for rural and urban populations. Higher occurrences of high blood pressure (47 compared to 25), hypertension (41 versus 19), stress (33 against 23), and anxiety (36 versus 23) are observed in urban populations, likely due to work-related pressures, poor dietary habits, and environmental stressors. Rural populations, in contrast, exhibit a higher number of cases of individuals with normal blood pressure (58 versus 41), indicating better cardiovascular health. Even though the rate of exercising in urban regions is greater (32 compared to 22), it does not fully counteract the negative consequences linked to urban living. Both demographic groups report abstaining from alcohol. In summary, urban populations face an elevated risk for cardiovascular and mental health challenges, while rural populations advantageously engage in a more natural way of life but may benefit from increased physical activity.

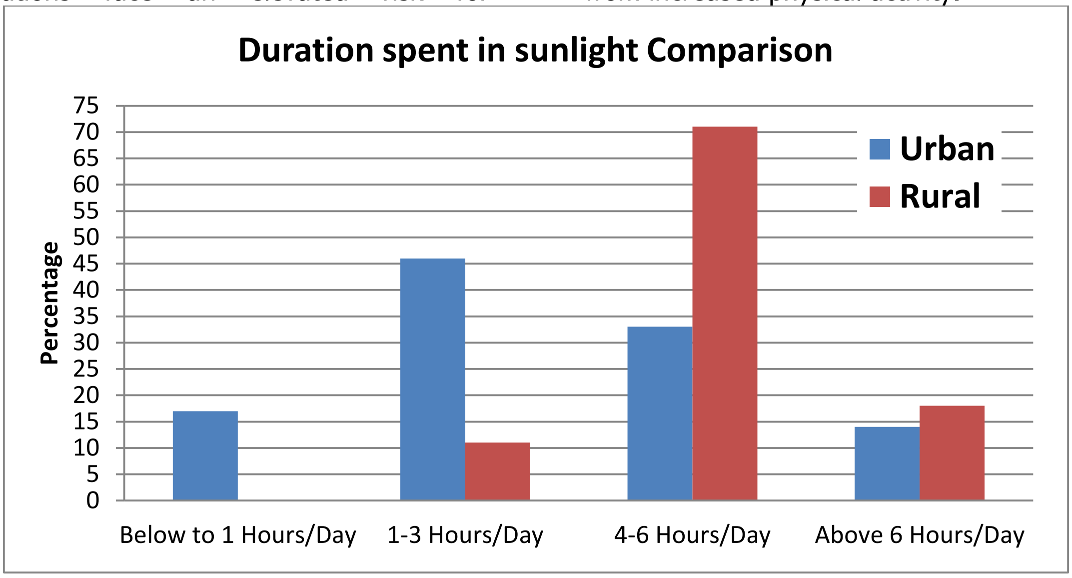

Figure.7: Duration spent in sunlight comparison of urban vs. rural populations

The table shows the variation in the number of hours spent on physical activity or work by urban and rural populations. People living in cities are usually less active, as 17 individuals engage in under an hour of daily activity, a figure that is absent in rural areas. Moderate physical activity (1-3 hours/day) is more common in urban areas (46 compared to 11 in rural areas), indicating limited physical involvement. Rural populations, by contrast, exhibit significantly greater activity levels, with 71 individuals participating in 4-6 hours of daily physical activity compared to only 33 urban residents. Additionally, more rural individuals (18) partake in over 6 hours of activity each day compared to 14 from urban areas, highlighting the labor-intensive nature of rural jobs.

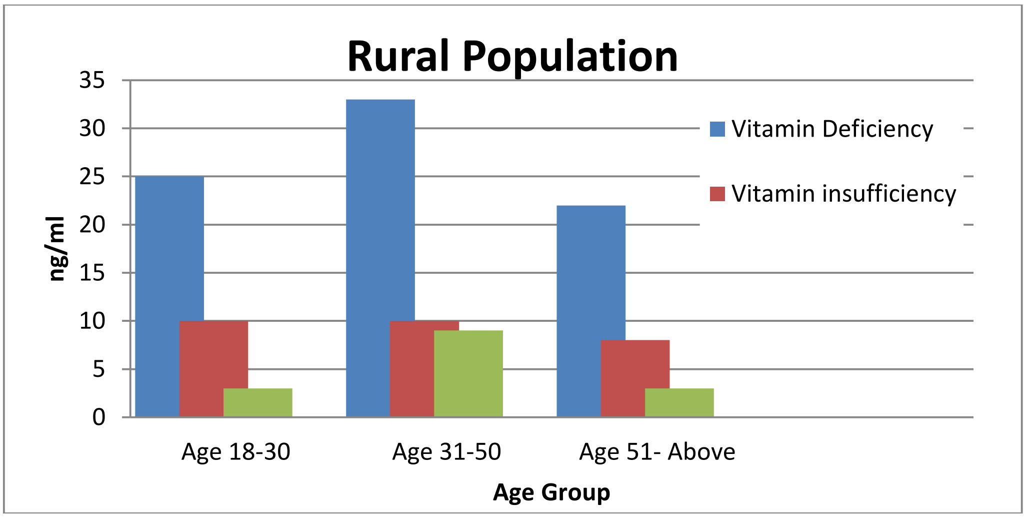

Figure 8: Description of vitamin status across age groups

The data categorizes individuals into three age groups—18–30, 31–50, and 51 and older—based on their vitamin status, which includes the classifications of deficiency, insufficiency, sufficiency, and intoxification. Individuals aged 31–50 are the most likely to be vitamin deficient, with 33 individuals in this group, followed by 25 individuals aged 18–30 and 22 individuals aged 51 and above. There are 10 instances of vitamin insufficiency in both the 18–30 and 31–50 age groups, while the 51 and older group has 8 cases, representing a slight decrease.

Vitamin sufficiency levels are relatively low across all age categories. The group aged 31 to 50 had the highest number, with nine individuals, while the groups aged 18 to 30 and 51 and older each had three. Across all age groups, there is no occurrence of vitamin intoxication, and no one is affected. Individuals across all age groups experience vitamin insufficiency or deficiency, but those aged 31 to 50 are particularly affected. None show signs of vitamin intoxication, and only a small number of individuals have adequate vitamin levels.

Table 1: Descriptive statistics of vitamin D levels in the urban populations across age groups"

Statistic	Age 18–30	Age 31–50	Age 51+
Mean	16.94	18.46	16.84
Median	15.25	15.1	15.7
Std Dev	7.86	11.36	9.05
Max	36	56	39
Min	5	4	6

The table summarizes the main descriptive statistics (mean, median, standard deviation, maximum, and minimum) for the three age groups of 18–30, 31–50, and 51+. The mean value is highest for the age group 31 to 50 (18.46), followed by the age group 18 to 30 (16.94) and the age group 51 and above (16.84). This suggests that the middle age group often has somewhat higher values compared to the younger and older groups. The median (middle value) is quite similar across all age groups: Alter 18–30: 15,25, Alter 31–50: 15,10, Alter 51+: 15,70. This indicates that the central tendency remains fairly stable, implying that the typical value across the three groups is similar. The Age 31–50 category exhibits data that are more widely spread, with a variability of 11.36, the highest recorded. The Age 18–30 group shows more consistent values, as indicated by its low variability of 7.86. Maximum (Max): The Age 31–50 group contains several exceptionally high values (outliers), with 56.00 being the highest recorded value. The maximums for the age groups 18–30 and 51+ are 36.00 and 39.00, respectively. Minimum (Min): The absence of stated minimum numbers indicates that the table lacks information. Including the minimum values would facilitate the evaluation of the entire range and the identification of potential outliers at the lower end. The Age 31–50 group has both the highest average (18.46) and the highest standard deviation (11.36), indicating greater variability. In contrast, the distributions for the 18–30 age group (mean: 16.94, SD: 7.86) and the 51+ age group (mean: 16.84, SD: 9.05) exhibit greater stability. The medians of all groups were nearly the same (~15), suggesting that their central tendencies were comparable. In the 31–50 age group, the highest value reaches 56, indicating possible outliers. No minimum values were provided.

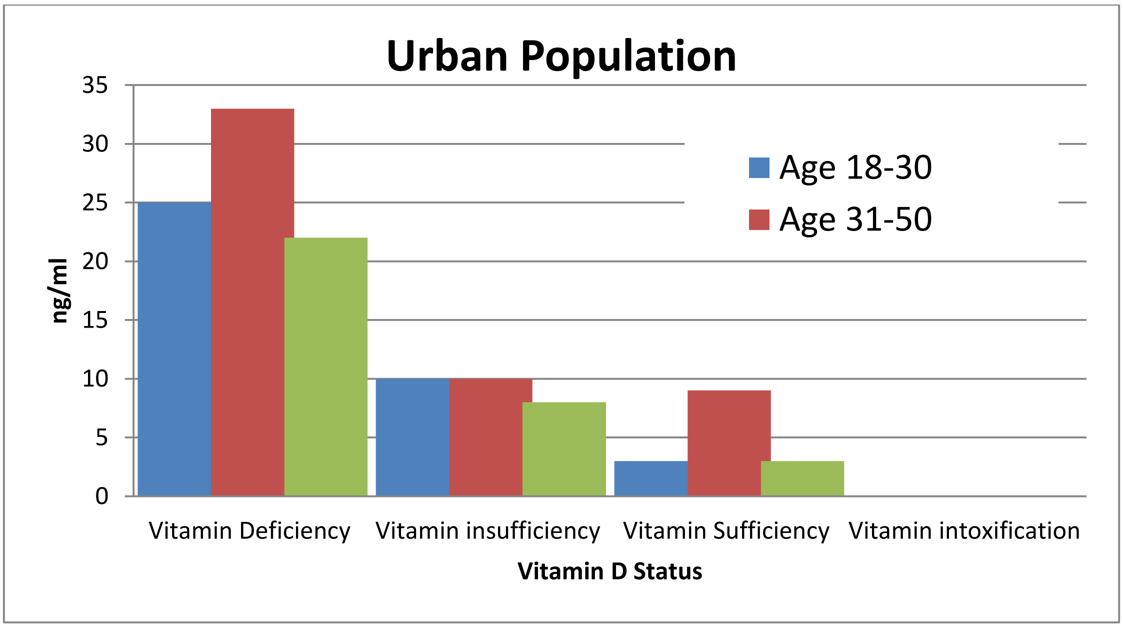

Figure 9: Vitamin status distribution across different age groups

The vitamin status in three age groups—18–30, 31–50, and 51 and older—is illustrated by this data. The status is categorized into deficiency, insufficiency, sufficiency, and intoxification. Vitamin Deficiency: Seen most often in individuals aged 31 to 50 (33 individuals). Following this, the 18–30 age group, comprising 25 individuals, ranked next. In the group of individuals aged 51 and older, there are 22 people with deficiencies. This implies that a lack of vitamins is prevalent, particularly in adults of middle age. People aged 18–30 and those aged 31–50 suffer from vitamin insufficiency in equal numbers (10 each). 8 individuals, a number that is slightly lower than that in the 51-and-over category. suggests an issue that appears to be somewhat persistent across all age demographics. All groups show relatively low levels of vitamin sufficiency. The 31–50 age group had nine individuals with the highest number, while the 18–30 and 51+ age groups each had only three. highlights the general shortfall of the population in vital vitamin levels. Vitamin Intoxification: The absence of documented cases of vitamin intoxification across all age categories indicates that this condition is rare in this demographic. The results indicate that vitamin deficiency and insufficiency are common in all age groups, especially among individuals aged 31 to 50. The markedly inadequate vitamin sufficiency and lack of instances of intoxification highlight the necessity for enhanced nutritional understanding and possible supplementation, particularly among younger and middle-aged individuals.

DISCUSSION

Deficiency of vitamin D is widespread worldwide, the Middle East included. Insufficient exposure to sunlight is believed to be the primary cause of vitamin D deficiency (Holick & Chen, 2008; Moan et al., 2008). Despite the abundance of sunny days throughout the year (around 320 days), vitamin D deficiency remains common. This is due to various factors, such as traditional clothing influenced by social, religious, and environmental values. While women generally cover their entire bodies, including hands and faces, men typically cover most of their bodies but leave their hands and faces uncovered to protect themselves from direct sunlight. Additional factors include shift work, indoor employment, avoiding dairy, and using sunscreen (Looker et al., 2008). Due to smart devices, television, and a decrease in outdoor recreational areas, the modern urban lifestyle has affected sun exposure patterns by causing people to spend more time indoors. Furthermore, it has been found that people with darker skin need to be exposed to the sun three to five times longer than those with lighter skin in order to generate an equivalent amount of vitamin D (Matsuoka et al., 1987; Clemens et al., 1982). Furthermore, the research found that the overall results exhibited a high degree of heterogeneity ($I2 = 98.46\%$), which may have been influenced by factors such as gender and geographic location. When comparing countries, it was found that Pakistan exhibited the highest frequency at 73%, while Sri Lanka had the lowest at 48%. Bangladesh and India fell in between with a frequency of 67% (Krzywanski et al., 2016; Mavridou et al., 2018). The variation could be attributed to the differences in geographic location and sunlight exposure; while Bangladesh and India are situated in tropical and subtropical regions, Pakistan is in a subtropical zone that receives relatively less sunlight. China (70%) and Iran (56%) also exhibited similar high rates of insufficiency. (Vatandost et al., 2018; Wei et al., 2019). Moreover, gender differences indicate that in South Africa, Vitamin D Deficiency is more prevalent among women (76%) compared to men (51%), likely due to cultural norms that limit women's outdoor exposure. The World Bank (2020) reports that women constitute approximately 24% of South Africa's labor force, while men account for 80%. Moreover, conventional dressing practices such as hijabs, burqas, and other full-body garments restrict sun exposure, leading to a higher occurrence of insufficiency among women. Reports indicate that these clothing practices have increased significantly over the past thirty years (Shams, 2016).

In addition, women during the first trimester of pregnancy were more likely to experience both vitamin D insufficiency and deficiency than those in the second trimester. These results aligned with previous research (Cross et al., 1995; Vandevijvere et al., 2012). The rise in vitamin D levels during the second trimester is likely due to hormonal and metabolic changes linked to pregnancy. However, it is still unclear how pregnancy affects 25 (OH) D levels (Moon et al., 2020).

CONCLUSION

This research underscores distinct disparities in serum vitamin D levels between urban and rural adults, with urban populations exhibiting lower levels due to restricted sun exposure and lifestyle influences. Vitamin D deficiency or insufficiency is prevalent among most individuals in both settings, particularly those aged 31–50 years. The increased physical activity among rural youth further illustrates the differences in environment and lifestyle. The findings highlight the necessity for focused public health initiatives, including nutrition education, vitamin D supplementation, and lifestyle changes, to enhance vitamin D levels and lipid profiles, thereby decreasing the risk of cardiovascular and related health issues in both communities. By providing valuable insights into the impact of lifestyle and geographic factors on blood vitamin D and lipid profiles, this study establishes a foundation for future research and the development of health policies across various populations.

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