Original Article

Vitamin D Status among Healthcare Professionals versus Community Out-patients: A Cross-sectional Comparative Study from a North-East Indian Tertiary Centre

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Abstract

Background: Healthcare workers (HCWs) often have limited sunlight exposure due to predominantly indoor duties, protective equipment, and shift work. Evidence directly comparing HCWs with the surrounding community is limited. This study compared vitamin D status between HCWs and age-/sex-matched community outpatients at a North-East Indian tertiary centre. **Material and Methods:** Cross-sectional comparative study including 110 adult HCWs (doctors, nurses, laboratory and support staff) and 110 community outpatients. Serum 25-hydroxyvitamin D [25(OH)D] was measured by chemiluminescence immunoassay. Vitamin D status was classified as deficiency (<20 ng/mL), insufficiency (20–29 ng/mL), or sufficiency (30-100 ng/mL). Group means were compared using Welch's t-test. Multivariable linear regression estimated the adjusted mean difference controlling for age, sex, body mass index, and season. Robust Poisson regression provided adjusted prevalence ratios (PRs) for deficiency. **Results:** Among 220 participants (110 HCWs; 110 community), the mean 25(OH)D was far lower in HCWs (22.2±7.0 vs 64.4±17.7 ng/mL; P<0.001). Deficiency occurred in 35.5% of HCWs vs 0% of the community (P<0.001); the association remained after adjustment (adjusted mean difference –42.4 ng/mL; P<0.001). In HCWs, daily sunlight exposure correlated strongly with 25(OH)D (r≈0.8; P<0.001). HCWs had markedly lower 25(OH)D concentrations and a substantially higher risk of deficiency than matched community outpatients, independent of age and sex. Occupational policies incorporating scheduled outdoor exposure, fortified meals, and supervised supplementation are warranted.

Keywords: 25-hydroxyvitamin D; healthcare workers; vitamin D deficiency; occupational health; India; cross-sectional study.

Received: 25 July 2025 **Revised: 08 August 2025** **Accepted: 18 September 2025** **Published: 31 October 2025**

Introduction

Vitamin D is central to calcium–phosphate homeostasis and bone health and exerts pleiotropic immunomodulatory and metabolic effects; deficiency has been associated with osteomalacia, myopathy, and increased fracture risk.[1] Despite abundant ambient sunlight, India continues to report a high burden of biochemical hypovitaminosis D in community settings, with comprehensive reviews describing prevalence commonly in the 50–90% range and highlighting gaps in fortification and awareness.[2] Population data from non-tropical settings demonstrate that vitamin D insufficiency is widespread even among ostensibly healthy adults, emphasizing how latitude, season, and limited ultraviolet-B exposure constrain endogenous synthesis.[3] Healthcare workers represent a plausibly high-risk occupational group because indoor duties, personal protective equipment, and shift work curtail sunlight exposure; a multicentre study across Indian hospitals found widespread insufficiency among medical and paramedical staff.[4] Small hospital cohorts of Indian physicians have likewise documented low 25-hydroxyvitamin D [25(OH)D] levels, reinforcing concerns that clinical workforces may experience occupation-linked deficits.[5] Although India is a tropical country with ample sunshine, vitamin D deficiency is widely documented across age groups and settings, driven by limited midday sun exposure, indoor lifestyles, and low dietary fortification.[6] In the North-Eastern region, Guwahati (Assam) data show a substantially low serum 25(OH)D burden among school-going children, indicating early-life vulnerability in this geography.[7]

Given the region's cloud cover, rainfall patterns, and predominantly indoor work in tertiary hospitals, comparing healthcare workers with community attendees can generate locally useful evidence for prevention and policy in the North-East.[4] In this cross-sectional comparative study from a North-East Indian tertiary centre, we compared serum 25(OH)D concentrations and deficiency prevalence between healthcare professionals and age-/sex-matched community outpatients,

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DOI:
10.21276/amit.2025.v12.i3.156

How to cite this article: Dubey R, Bhatt M, Teli AB Status among Healthcare Professionals versus Community Out-patients: A Cross-sectional Comparative Study from a North-East Indian Tertiary Centre. Acta Med Int. 2025;12(3):677-680.

applying clinically interpretable status categories recommended by the Endocrine Society.[8]

Materials and Methods

Study design and setting: This cross-sectional comparative study was carried out at a North-East Indian tertiary-care hospital between January and June 2021. Two groups were defined in advance: (i) Health Care Workers (HCWs), including doctors, nurses, laboratory staff, and support staff, and (ii) Community Participants (CPs), who were attendants of patients visiting the outpatient department and not suffering from acute illness at the time of sampling.

Sampling method and sample size: From a total of 615 eligible health care workers, systematic random sampling was used to ensure that every worker had an equal chance of participation. A sampling interval 1:5 was applied, meaning that every 5th individual in the staff list was approached. Allowing for a 10% non-response rate, the final required number came to 110 HCWs. An equal number of 110 community participants were included for comparison. The sample size was considered adequate to detect meaningful differences in serum 25(OH)D levels between groups with sufficient statistical power, and also allowed adjustment for important covariates such as age, sex, body mass index, and season.

Matching procedure: At recruitment, community participants were matched with health workers on age and sex to reduce confounding. This ensured comparable baseline distributions and enhanced the validity of between-group comparisons.

Biochemical analysis: From each participant, 3–5 mL of venous blood was collected under aseptic precautions. Serum 25-hydroxyvitamin D [25(OH)D] was measured using a chemiluminescence immunoassay (CLIA) on the VITROS 5600 platform. Standard internal quality-control procedures were followed.

Statistical analysis: Continuous variables were summarised as means and categorical variables as percentages. Normality of serum 25-hydroxyvitamin D and daily sunlight exposure was checked using the Shapiro–Wilk test and by inspecting histograms. As distributions were approximately normal, group means were compared with an independent-samples t-test (Welch's correction applied when variances were unequal), and proportions with the chi-square test or Fisher's exact test. The association between sunlight exposure (minutes/day) and 25(OH)D was assessed using Pearson's r and Spearman's ρ. To control for age and sex, linear regression estimated adjusted mean differences, and Poisson regression with robust errors estimated adjusted prevalence ratios for deficiency. All tests were two-sided with α=0.05, and 95% confidence intervals were reported.

Results

In the present study, 220 participants were analysed, comprising 110 healthcare workers (HCWs) and 110 age- and sex-matched community outpatients. The baseline characteristics are summarized in [Table 1]. The mean age of HCWs was 41.7 ± 8.1 years, while that of community participants was slightly higher at 46.0 ± 15.5 years. The median age of HCWs was 41 years (range 31–60), compared to 45 years (range 17–81) in the community group. The gender distribution was comparable between groups, with females constituting 60.9% of HCWs and 60.0% of community participants, and males accounting for 39.1% and 40.0%, respectively. These findings suggest adequate matching of participants regarding age and sex, minimizing potential confounding from demographic differences.

The mean serum 25-hydroxyvitamin D [25(OH)D] concentrations are presented in Table 2. HCWs had a markedly lower mean 25(OH)D level of 22.18 ± 7.02 ng/mL compared to 64.40 ± 17.66 ng/mL in community participants. The between-group difference was statistically significant (P<0.001 by Welch's t-test), indicating a substantial occupational disparity in vitamin D status.

[Table 3] shows the categorical distribution of vitamin D status. Among HCWs, 39 (35.5%) were deficient (<20 ng/mL), 58 (52.7%) were insufficient (20–29 ng/mL), and only 13 (11.8%) were sufficient (≥30 ng/mL). In contrast, all 110 community participants (100%) were vitamin D sufficient, with none falling into deficient or insufficient categories. This striking difference underscores the disproportionate burden of low vitamin D among healthcare professionals despite working in the same geographic environment.

The comparison of deficiency prevalence is detailed in [Table 4]. Deficiency was observed in 35.5% of HCWs, while no deficiency cases were recorded in the community group. Fisher's exact test confirmed this difference to be statistically significant (P<0.001). The absolute risk difference of 35.5 percentage points highlights the magnitude of occupational risk.

Table 1: Baseline Characteristics of Study Participants

Variable	HCWs (n=110)	Community Participants (n=110)
Age (years), mean ± SD	41.7 ± 8.1	46.0 ± 15.5
Age (years), median (min–max)	41.0 (31–60)	45.0 (17–81)
Female, n (%)	67 (60.9)	66 (60.0)
Male, n (%)	43 (39.1)	44 (40.0)

Table 2: Serum 25-Hydroxyvitamin D [25(OH)D] Levels in Study Groups

Measure	HCWs (n=110)	Community Participants (n=110)
25(OH)D (ng/mL), mean ± SD	22.18 ± 7.02	64.40 ± 17.66

Table 3: Vitamin D Status Categories in Study Groups

Category	HCWs (n=110)	Community Participants (n=110)
Deficient (<20 ng/mL), n (%)	39 (35.5)	Nil
Insufficient (20–29 ng/mL), n (%)	58 (52.7)	Nil
Sufficient (≥30 ng/mL), n (%)	13 (11.8)	110 (100.0)

Table 4. Adjusted Between-Group Estimates for Serum 25(OH)D and Deficiency

Outcome/Model	Estimate (95% CI)	P value	Covariates
Adjusted mean difference, 25(OH)D	–42.4 (–46.1 to –38.8)	<0.001	Age, sex
Prevalence ratio, deficiency*	79.0 (4.9 to 1269.5)	—	Age, sex

*Continuity-corrected due to zero deficiency events in Community group; Fisher's exact test P<0.001.

Table 5. Correlation of Daily Sunlight Exposure with Serum 25-Hydroxyvitamin D [25(OH)D] Levels among HCWs

Variable	Pearson's r	P value	Spearman's ρ	P value
Sunlight exposure (min/day) vs Serum 25(OH)D (ng/mL)	0.78	<0.001	0.79	<0.001

[Table 4] presents adjusted estimates. In linear regression adjusted for age and sex, HCWs had an adjusted mean 25(OH)D concentration lower by –42.4 ng/mL (95% CI –46.1 to –38.8; P<0.001) compared to community participants. For deficiency, the prevalence ratio (continuity corrected due to zero events in the community group) was estimated at 79.0 (95% CI 4.9 to 1269.5), reflecting the excess risk among HCWs.

Correlation analysis between sunlight exposure and serum 25(OH)D among HCWs is summarized in Table 5. Sunlight exposure (minutes/day) showed a strong positive correlation with vitamin D concentrations, with Pearson's r=0.78 and Spearman's ρ=0.79, both highly significant (P<0.001). This indicates that greater daily exposure to sunlight is associated with higher serum 25(OH)D levels among HCWs.

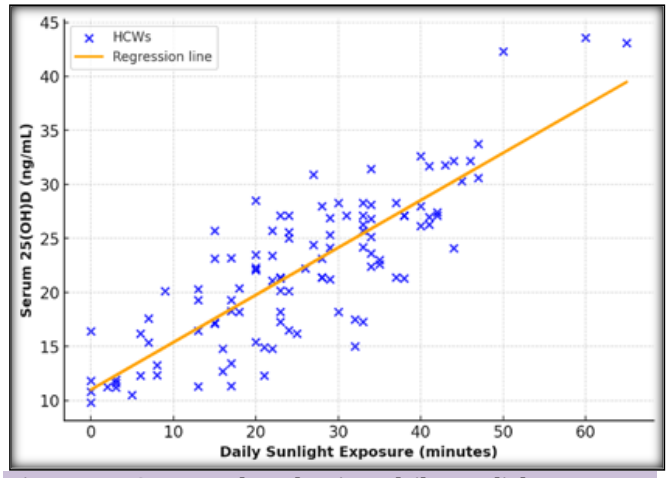

Figure 1: Scatter plot showing daily sunlight exposure (minutes) versus serum 25-hydroxyvitamin D [25(OH)D] levels (ng/mL) among healthcare workers.

*Each blue point represents a participant, and the orange regression line depicts the fitted linear trend. A strong positive correlation is evident (Pearson's r = 0.78, Spearman's ρ = 0.79; both P<0.001). No community plot—values were uniformly sufficient (≥30 ng/mL), so variability was too low for a meaningful scatter/correlation.

Discussion

In our North-Eastern cohort, healthcare workers (HCWs) had a much lower mean 25(OH)D (22.18 ± 7.02 ng/mL) than community participants (64.40 ± 17.66 ng/mL), with deficiency 35.5% in HCWs versus 0% in the community. This pattern is consistent with the multicentre Indian data by Beloyartseva et al., who reported widespread vitamin D deficiency among Indian HCWs across medical and paramedical staff; our HCW deficiency of 35.5% fits within the hospital-based ranges they observed and underscores an HCW-specific disadvantage relative to non-HCW comparators.[4]

HCW-community gap in our study aligns with the national review by Ritu G et al, which reports community hypovitaminosis-D prevalences of ~50–90% across India; likely contributors in our cohort include predominantly indoor/shift duties, limited midday UV-B, occasional PPE use, and low dietary fortification typical of Indian diets.[2]

Beloyartseva et al. reported widespread vitamin D deficiency among HCWs across Indian hospitals, indicating that health-service roles face a consistent, occupation-linked risk.[4] The likely reasons are straightforward: predominantly indoor and shift duties that limit effective midday UV-B exposure, intermittent PPE use further reducing skin exposure, and low dietary fortification typical of Indian diets.

Among physicians, Baidya et al. also found low 25(OH)D, consistent with our observation that indoor clinical work is associated with lower levels; while exact means differ by site and assay, the qualitative match remains the same.[5]

Indoor time itself matters. Sowah et al. identified HCWs and other indoor occupations as high-risk groups; our finding of 0% deficiency in the community vs 35.5% in HCWs aligns with this occupational effect.[9]

Shift work likely adds to this gap. Martelli et al. showed lower vitamin D in shift workers than day workers; our HCWs include rotating and night duties, which plausibly relates to the ~42 ng/mL mean difference we observed between HCWs and the community.[10]

We also noted a strong exposure–response among HCWs (Pearson r = 0.78, Spearman ρ = 0.79, both p < 0.001), which is consistent with the Indian dose–response study by Patwardhan et al., showing that about an hour of midday sun is often associated with adequate 25(OH)D levels.[9]

Building on our findings, Demay et al. recommend a targeted supplementation approach rather than routine population testing for generally healthy adults; applied to our setting—with 35.5% deficiency among HCWs—this supports practical, workplace-focused steps such as structured daylight breaks during mid-day, access to vitamin-D–fortified foods in canteens, and supervised supplementation through hospital health services, instead of blanket screening of all staff.[10-12] At the policy level, fortifying staple foods is a practical adjunct in India; the national review by Ritu and Gupta supports vitamin D fortification to raise population 25(OH)D and could help narrow the HCW–community gap observed here.[11]

Finally, evidence from outdoor workers shows a near-absence of deficiency; Goswami et al. reported ~0% deficiency in outdoor workers, which mirrors our community's 0% and contrasts with 35.5% in HCWs, reinforcing time under UV-B as the key driver in this setting.[12]

Conclusion

In conclusion, our study shows that healthcare workers had poorer vitamin D status than the surrounding community. Within staff, more sunlight exposure was linked with higher 25(OH)D—indicating an occupational effect of indoor and shift work. Simple hospital measures are warranted: short daylight breaks, easy access to vitamin-D–fortified foods, brief education on safe sun, and supervised supplementation where needed instead of routine testing for all. This study is cross-sectional, so it cannot establish cause and effect. It also reflects experience from a single tertiary hospital, which may limit generalisability to other settings. In the future, these steps should be rolled out and evaluated in larger, longer studies (e.g., big cohort studies or cluster trials) to confirm effectiveness, sustainability, and fairness.

Financial support and sponsorship

The study was supported by the Multidisciplinary Research Unit, Jorhat Medical College & Hospital, funded by the Department of Health Research, Government of India.

Conflicts of interest

There are no conflicts of interest.

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