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Serum vitamin D, sun exposure and clinical attributes of local patients with respiratory allergies

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ABSTRACT

Background: Involvement of vitamin D deficiency has been suggested in respiratory allergies which are common all over the world. Inadequate sun exposure has been associated with vitamin D deficiency as cutaneous synthesis of vitamin D occurs in sunlight. The present study examined serum vitamin D status and sun exposure in patients having respiratory allergies. *Materials and Methods:* Adult patients having respiratory allergies (n=35) were compared with age-matched controls without any respiratory allergy (n=35). Sun exposure and serum vitamin D levels were determined. Subjects were further segregated on the basis of their duration of sun exposure and vitamin D status. *Results:* Serum vitamin D levels were not different between the groups (controls 37.06 $\pm$ 20.91 ng/ml v/s patients 40.07 $\pm$ 10.97 ng/ml, p=0.380). Sun exposure-based analysis also did not reveal any difference in serum vitamin D levels.74.28% of the controls and 48.57% of patients had less than 1-hour daily sun exposure. *Conclusion:* Vitamin D levels in patients having respiratory allergies are comparable to non-allergic healthy individuals. Longer sun exposure seems to have adverse influence on respiratory allergies.

Keywords: Respiratory Allergy, Vitamin D, Sun exposure

1. INTRODUCTION

Respiratory allergies are a major global health concern and affect around 10-25% of the population (Charpin et al., 2000). The most common respiratory allergies include seasonal or perennial allergic rhinitis and bronchial asthma. Various external environmental factors have been highlighted in the development or exacerbation of respiratory allergies such as pollens, dust mites, household pests, pollutants, microbes and furred pets (Baldacci et al., 2015; Burbank et al., 2017; Gilles et al., 2018). Vitamin D deficiency has been linked to the development of respiratory allergies through its potential role in the early stages of immune development (Bozzetto et al., 2012). Sunlight is an indirect natural source of vitamin D as cholecalciferol, a precursor of vitamin D, is synthesized in the skin on exposure to ultraviolet radiations from the sun (Christakos and Bikle, 2020). Restricted sun exposure due to a predominantly indoor lifestyle can lead to vitamin D inadequacy and allergic manifestation (Jones et al., 2012). Reduction in sun exposure due to a lifestyle of sun avoidance and consequently low vitamin D levels have been suggested to correlate with an increase in the incidence of respiratory allergies (Weiss and Litonjua, 2007). However, vitamin D supplementation for the prevention of respiratory allergies has yielded inconsistent findings. Higher vitamin D intake and increased sun exposure have been linked to decreased risk for respiratory allergies (Camacho et al., 2016). On the other hand, long sun exposure, increased outdoor time and vitamin D supplementation has been associated with worsening of allergic asthma through activation of vitamin-D mediated immune response (D'Cruz et al., 2018). The present study was conducted to determine sun exposure and serum vitamin D levels in patients having respiratory allergies and ascertain the impact of sun exposure on vitamin D status.

2. MATERIALS AND METHODS

The cross-sectional analytical study was conducted between June 2020 and December 2020 in agreement with the principles laid down in the Helsinki declaration for ethical research.

Study population

Non-random convenience sampling was done to recruit a total of 70 subjects from the local population of Lahore, Pakistan. Written and oral informed consent was obtained from each individual participant included in the study. Adult men and women aged 15 to 65 years having a known respiratory allergy were included in the study group (n=35) while age-matched subjects without any known history of respiratory allergy were included as controls (n=35). Subjects having history of autoimmune, bone, kidney and/or liver disorders were excluded. Subjects using steroids for any clinical indication were also excluded. Relevant demographic data (age, sex) were recorded in a strictly confidential and completely anonymous manner.

Assessments and procedures

Detailed clinical history and signs and symptoms of allergy were also documented. Sun exposure for a typical working day was estimated by utilizing a validated questionnaire that takes into account various factors including the time of day and duration of sunlight exposure, occupation, clothing and head gear for calculating average daily sun exposure (Patwardhan et al., 2018). Subjects within each group were further segregated based on the results of the sun exposure questionnaire into those having 1) daily sun exposure of less than one hour, 2) daily sun exposure between one to two hours and 3) daily sun exposure of more than 2 hours. 5 mL of venous blood was collected and serum samples were separated and stored at -20^{o}C until analysis. Serum vitamin D (25-hydroxy cholecalciferol) levels were measured using electrochemiluminescence binding assay (Elecsys® vitamin D total assay, Roche Diagnostics, Switzerland) on Cobas® e411 analyzer. Based on the established recommendations, serum vitamin D levels were used to define vitamin D status as; sufficient (>30 ng/mL), insufficient (20–29.9 ng/mL) or deficient (<20 ng/mL). Subjects within each group were also categorized based on their vitamin D status.

Statistical analysis

Data were analyzed in an anonymized form using Statistical Package for Social Sciences (SPSS), version 23. Descriptive data were presented as frequencies and percentages while group mean differences were assessed using independent sample t-test.

3. RESULTS

On the basis of presence or absence of respiratory allergies, the participants (n=70) were grouped into two; study group (respiratory allergy patients, n=35) and control group (non-allergic healthy individuals, n=35). No age difference was observed between the two groups (Control group 40.82$\pm$ 15.23 years v/s Study group 41.02 $\pm$ 14.30 years, p=0.841). No difference was observed in serum vitamin D levels between the groups (Control group 37.06$\pm$ 20.91ng/ml v/s Study group 40.07$\pm$ 10.97 ng/ml, p=0.380). Further

grouping based on sun exposure also did not reveal any difference in serum vitamin D levels in either of the control group or the study group (Table 1, Figure 1).

Table 1 Between groups comparison of serum vitamin D levels based on sun exposure

Serum vitamin D levels (ng/ml)	Daily sun Exposure			p-value
	< 1 hour	1-2 hours	> 2 hours	
Control Group	36.01 ± 22.56	33.62 ± 11.80	57.35 ± 13.22	0.358
Study Group	37.44 ± 9.85	41.32 ± 13.24	42.51 ± 9.57	0.340

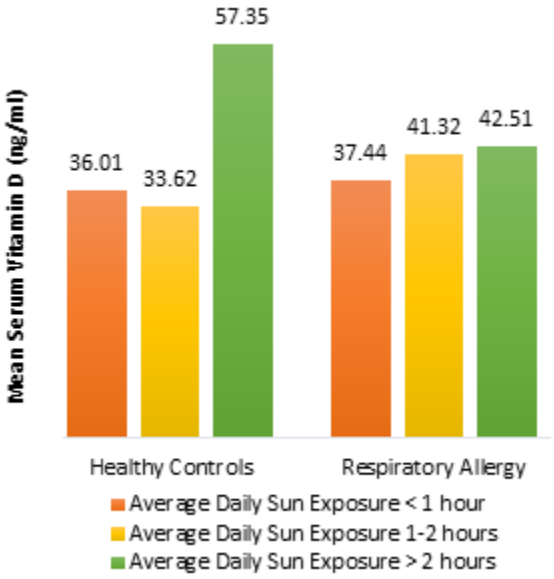

Figure 1 Bar diagram showing comparison of mean serum vitamin D levels between healthy controls and patients with respiratory allergy based on their average daily sun exposure

Table 2 Distribution of subjects according to serum vitamin D status and sun exposure

Group	Vitamin D status	Daily sun Exposure			Total; n (%)
		< 1 hour	1–2 hours	> 2 hours/day	
Control	Sufficient	16 (45.71%)	4 (11.42%)	2 (5.71%)	22 (62.85%)
	Insufficient	6 (17.14%)	2 (5,71%)	0 (0%)	8 (22.85%)
	Deficient	4 (11.42%)	1 (2.85%)	0 (0%)	5 (14.28%)
	Total; n (%)	26 (74.28%)	7 (20.00%)	2 (5.71%)	35 (100%)
Study	Sufficient	13 (37.14%)	8 (22.85%)	6 (17.14%)	27 (77.14%)
	Insufficient	3 (8.57%)	3 (8.57%)	1 (2.85%)	7 (20.00%)
	Deficient	1 (2.85%)	0 (0%)	0 (0%)	1 (2.85%)
	Total; n (%)	17 (48.57%)	11 (31.42%)	7 (20.00%)	35 (100%)

More patients in study group had longer daily sun exposure as compared to control group (Table 2). As expected, the allergic signs and symptoms were far more common in the study group as compared to the control group (Table 3). The comparison of potential allergic risk factors between the two groups showed a much higher frequency of smoking in the study group (Table 4). Dietary patterns were similar in both groups.

Table 3 Distribution of signs & symptoms associated with allergy

Clinical Feature	Control group; n (%)	Study group; n (%)
Runny/Stuffy Nose	9 (25.71%)	35 (100%)
Itchy Nose	0 (0%)	32 (91.42%)
Sneezing	3 (8.57%)	34 (97.14%)
Itchy Eyes	0 (0%)	26 (74.28%)
Coughing	1 (2.85%)	20 (57.14%)
Night Cough	6 (17.14%)	6 (17.14%)

Table 4 Distribution of potential allergic risk factors

Risk Factor	Control Group; n (%)	Study Group, n (%)
Smoking	1 (2.85%)	17 (48.57%)
Alcohol Intake	0 (0%)	2 (5.71%)
Fish intake	4 (11.42%)	6 (17.14%)
Dairy products	34 (97.14%)	30 (85.71%)
Eggs	29 (82.85%)	26 (74.28%)
Offal (liver, kidney)	6 (17.14%)	8 (22.85%)

4. DISCUSSION

Respiratory allergies are a common health problem with considerable negative impact on the quality of life (QoL) of affected individuals. The potential protective role of vitamin D in allergic conditions has been suggested but inconsistency of results, and sometimes even contrary reports, have not permitted yielding conclusive recommendations (Alswailmi et al., 2020). The present study did not show any difference in serum vitamin D levels between patients with respiratory allergies and healthy individuals. Furthermore, sun exposure was not shown to be associated with higher serum vitamin D levels. The small sample size of the study was a limitation which could be addressed in future studies to derive robust outcomes. In the present study, more patients with respiratory allergies were shown to have longer sun exposure duration as compared to healthy individuals. Our findings also reflected much higher prevalence of both upper and lower airway symptoms in patients with respiratory allergies as has been described previously (Lordan et al., 2000; Navarro et al., 2017). The present results showed a much higher frequency of smoking in respiratory allergic patients. These findings are in accordance with previous studies which have highlighted smoking, both active and passive, as risk factors for respiratory allergies. Tobacco smoke has also been associated with aggravation of allergic symptoms (Hisinger-Molkanen et al., 2018; Lee et al., 2019).

Previously, in a study on the effect of sun exposure and vitamin D intake on respiratory allergies in Puerto Rican adults, Camacho et al. showed combined longer sun exposure and high vitamin D intake to be associated with lower respiratory allergic conditions (Camacho et al., 2016). Results of the present study are somewhat contrary to these but the present work did not account for vitamin D intake and instead only considered serum vitamin D levels. Furthermore, the sun exposure questionnaire used in the current study only helps group individuals based on their average daily sun exposure. Thus, absolute values of sun exposure could not be assigned for comparative analysis. Additionally, the present study is limited by several factors including small sample size, cross-sectional nature and non-random consecutive sampling. Furthermore, the single point determination of the duration sun exposure and serum vitamin D concentration is unlikely to be indicative of the same over a period of months or years.

In the present study, the frequency of longer sun exposure was higher in patients with respiratory allergies. These findings are concordant with previously reported results showing sun exposure to be associated with the development of symptoms in most asthmatic patients due to increased dermal synthesis of vitamin D. The use of sunscreen was also demonstrated to mitigate the negative effect of sunlight. Vitamin D supplementation in vitamin D deficient asthmatic patients was also shown to be associated with deterioration of respiratory problems in allergic patients (D'Cruz et al., 2018). Studies conducted previously have suggested environmental variations including sudden sharp changes in temperature and cold weather to be associated with increased susceptibility to respiratory allergies and exacerbation of allergic symptoms in affected individuals (D'Amato et al., 2018; Hyrkäs-Palmu et al., 2018). These environmental effects may be associated with increased outdoor activity and associated longer sun exposure in patients with respiratory allergies. Increased exposure to aero-allergens, possibly due to higher outdoor time and longer sun exposure duration, has been shown to cause worsening of respiratory allergic manifestations (Mitakakis et al., 2003).

5. CONCLUSION

The present work has generated local data on sun exposure and vitamin D status in respiratory allergies. Vitamin D status does not seem to differ between healthy individuals and those having respiratory allergies in the present cohort. Excessive sun exposure due to geographical location may have a role in the development of respiratory allergies in South Asian and Middle Eastern populations irrespective of vitamin D status. Prospective trials of sun-exposure and serum vitamin D levels with randomization are required to engender clinically relevant evidence on their role in respiratory allergies.

Authors' contribution

FKS, SIAS and MURP were involved in the concept, design, definition of intellectual content, literature search, manuscript preparation, manuscript editing and manuscript review. MZS and SJ was involved in the experimental study, data acquisition, statistical analysis, manuscript editing and manuscript review.

Disclosure of conflict of interest

The authors declare that they have no conflict of interest.

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Informed Consent

Written and oral informed consent was obtained from each individual participant included in the study. No identifying information of any participant was included in this manuscript.

Ethical Approval

The study was approved by the Research Committee of the College of Pharmacy, University of Hafr Al-Batin, Saudi Arabia (Approval No. RCCP/2020/02/Immunomodulation).

Data and materials availability

All data associated with this study are present in the paper.

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