

## CAN MONTH OF BIRTH AND UV RADIATION AFFECT MULTIPLE SCLEROSIS RISK IN PROVINCES OF IRAN?

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### ABSTRACT

**Introduction:** Multiple sclerosis (MS) is an inflammatory autoimmune disease of the central nervous system that affects women more than men. Environmental factors such as sunlight, through Ultraviolet (UV) radiation can have a pivotal role in MS prevalence. MS is more common in mid latitude temperate climatic areas, such as the northern United States, southern Canada and northern Europe. It has been shown that there is a low risk of MS in the hot, moist and extremely dry equatorial zone, and vice versa.

**Materials and methods:** In this study, UV radiation data as UV index were collected from a geographic database provided by The Environmental Health Information System of Islamic Republic of Iran. The monthly average UV index during pregnancy leading to 15th of each month has been used to create GIS maps by using ArcGIS 9.3.

**Results:** In this paper, It was focused on the potential effect of UV radiation on MS prevalence. It was found that there is a low maternal exposure to UV radiation in people born in April and May in all provinces of Iran and they can be more susceptible to MS.

**Conclusions:** This study shows that Iranian high exposure to UV radiation can reduce the risk of MS. It was indicated that Iran is a low risk area for MS and people born in April and May are more susceptible to MS due to low exposure to UV radiation. Thus, birth months could be considered as an important factor in MS prevalence.

### INTRODUCTION

Multiple sclerosis (MS) is a chronic autoimmune disease of the central nervous system (CNS) white matter, characterized by demyelination and axonal loss [1]. The cause of MS is not clear, but interactions between environmental factors, auto-antigens and the immune response in genetically susceptible individuals can be the leading cause of MS [2]. A low prevalence of MS in the geographic areas with high sunlight exposure has

been reported [3]. High sun exposure between the ages of 6 and 15 years has been proved to reduce the risk of MS [4]. It has been identified that MS is more common among people born in May, but people born in November have a reduced risk of developing MS [5,6]. The protective effect of vitamin D on MS has been considered. Thus, exposure to sunlight and vitamin D supplementation in pregnancy could reduce the risk of MS in the future generations [7]. It has been shown that UV

radiation exposure level during pregnancy might protect normal individuals from the development of MS and MS cases from disease progression [3]. Recent studies indicate the interaction of vitamin D metabolites with the immune system. Moreover, vitamin D could modulate a shift to an anti-inflammatory immune response, and increase the function of regulatory T cell [3]. It has been demonstrated that vitamin D could regulate innate and adaptive immune system. Moreover, vitamin D deficiency has effects on T cell differentiation and regulation [8]. Vitamin D receptor agonists may prevent the proinflammatory TH1 cells and decrease IL-17, which regulates the disease in experimental autoimmune encephalomyelitis (EAE) [9]. Although the major source for vitamin D is sunlight, vitamin D can be supplied in the food. But no relationship has been reported between frequency of MS and vitamin D from dietary food [10]. Exposure to UV radiation in sunlight may suppress immune system and synthesize vitamin D. Thus, it can protect against autoimmune diseases such as MS [11]. UV radiation has been proved to suppress skin immunity and three mechanisms have been described to suppress skin immunity: 1) DNA damage, 2) isomerisation of UCA to the suppressive cis form, and 3) oxidative stress (Fig. 1) [12,13]. It has been shown that exposure to UV radiation

in childhood is more important than in adulthood for beneficial and adverse effects. Moreover, stratospheric ozone depletion can increase ambient UV radiation in the UVB wavelength, which is of crucial importance in beneficial and deleterious health effects [13]. Ultraviolet B (290-320 nm) irradiation could affect the mammalian immune system. Low dose of UVB irradiation ( $50\text{--}100\text{ mJ cm}^{-2}$ ) has been shown to be immunosuppressive [14]. UVB ray can be the most harmful ray that affects the epidermis. It has been proved that over exposure to UVB may cause detrimental effect on human health such as cell cycle arrest, inflammation and photocarcinogenesis. Moreover, the UV region is identified as an important factor, because several biological actions are in the UV region and the energy per photon can increase with a reduction of wavelength [15,16].

## MATERIALS AND METHODS

### *Characterization of the study area*

The area under investigation is Iran, which is located approximately between  $25^{\circ}\text{N}$  and  $40^{\circ}\text{N}$  in latitude and between  $44^{\circ}\text{E}$  and  $64^{\circ}\text{E}$  in longitude Fig.1 [17]. Iran is subdivided into thirty one provinces. Many areas of Iran have arid and semi-arid climates [17]. According to recent studies, Iran is considered as a low risk area for MS [18].

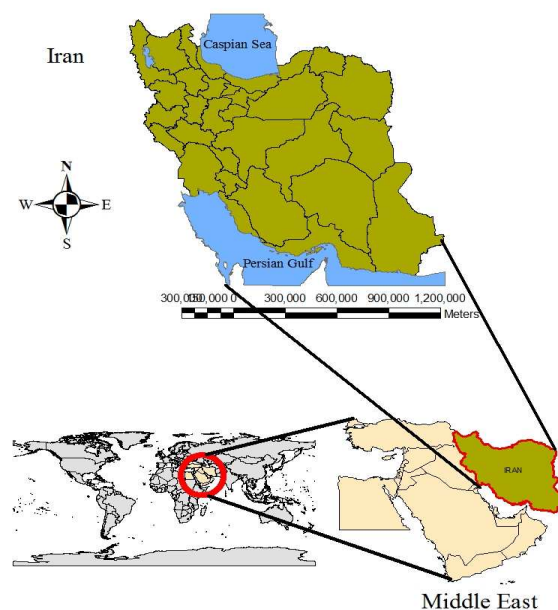


Fig. 1. Location of study area

### Collection and preprocessing of data

These data were extracted from a geographic database provided by The Environmental Health Information System of Islamic Republic of Iran (data for UV radiation is available at: <http://en-health.tums.ac.ir>). The duration of pregnancy is considered to be 283 days and we investigate the potential effect of UV on people born in 15th of

each month (Table. 1). Moreover, the UV radiation distribution maps presented here are based on the mean 283- day daily maximum UV radiation. In order to achieve the spatio- temporal modeling of UV radiation index (UVI) over the Iranian provinces, the ArcGIS 9.3, developed by ESRI, has been used.

Table. 1. The duration of pregnancy leading to 15<sup>th</sup> of each month of the Iranian calendars that converted to the Gregorian Calendar.

ID	Pregnancy duration	
	From	To
a	2011/06/29	2012/04/03
b	2011/07/30	2012/05/04
c	2011/08/30	2012/06/04
d	2011/09/30	2012/07/05
e	2011/10/29	2012/08/05
f	2011/11/27	2012/09/05
g	2011/12/26	2012/10/06
h	2012/01/25	2012/11/05
i	2012/02/24	2012/12/05
j	2011/03/25	2012/01/05
k	2011/04/27	2012/02/04
l	2011/05/28	2012/03/05

## RESULTS AND DISCUSSION

The exposure to UV radiation in people born in April and May is low in most of provinces of Iran. Thus, probably there is a high risk of MS in most of provinces in these months except in Sistan and Baluchestan, Fars, Boshahr and Markazi (Fig. 2). In other months there is a high exposure to UV radiation. Thus, we expect low risk of MS in these months (Fig. 3, 4, 5). UV radiation can have beneficial and deleterious health effects. Vitamin D may suppress immune system. Thus, the protective effect of vitamin D in MS has been proved and low exposure to UV radiation can cause vitamin D deficiency. On the other hand, high exposure to UV radiation can cause skin cancer or eye

disease. Thus, exposure time and radiation dose must be optimized to provide its potential health benefits [13]. In this graph, it has been shown that UV index (UVI) is more than 5 in most months of the year. Thus, it can be a good reason why Iran is a low risk area for MS and Iranian born in April and May are more susceptible to MS due to low exposure to UV radiation. High UVI has been reported in all provinces of Iran during September, October, November and December months in Iran which is shown that there is a low risk of MS in people born in these months. But, high risk of MS has been identified in people born in April and May and this is due to low exposure to UV radiation in winter (Fig. 6).

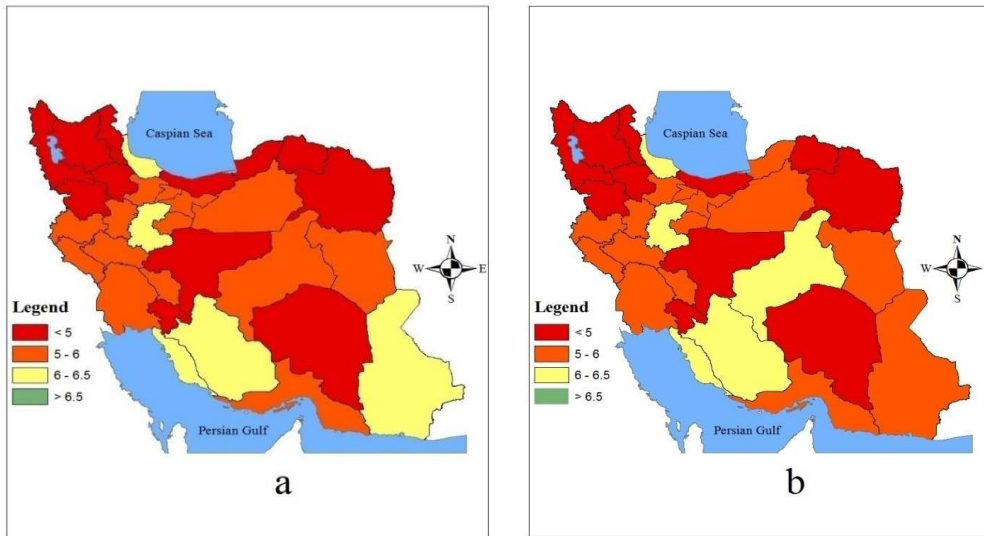


Fig. 2. Maps of potential UV exposure in people born in April (a) and May (b) in Iran based on 2012 UVI data.

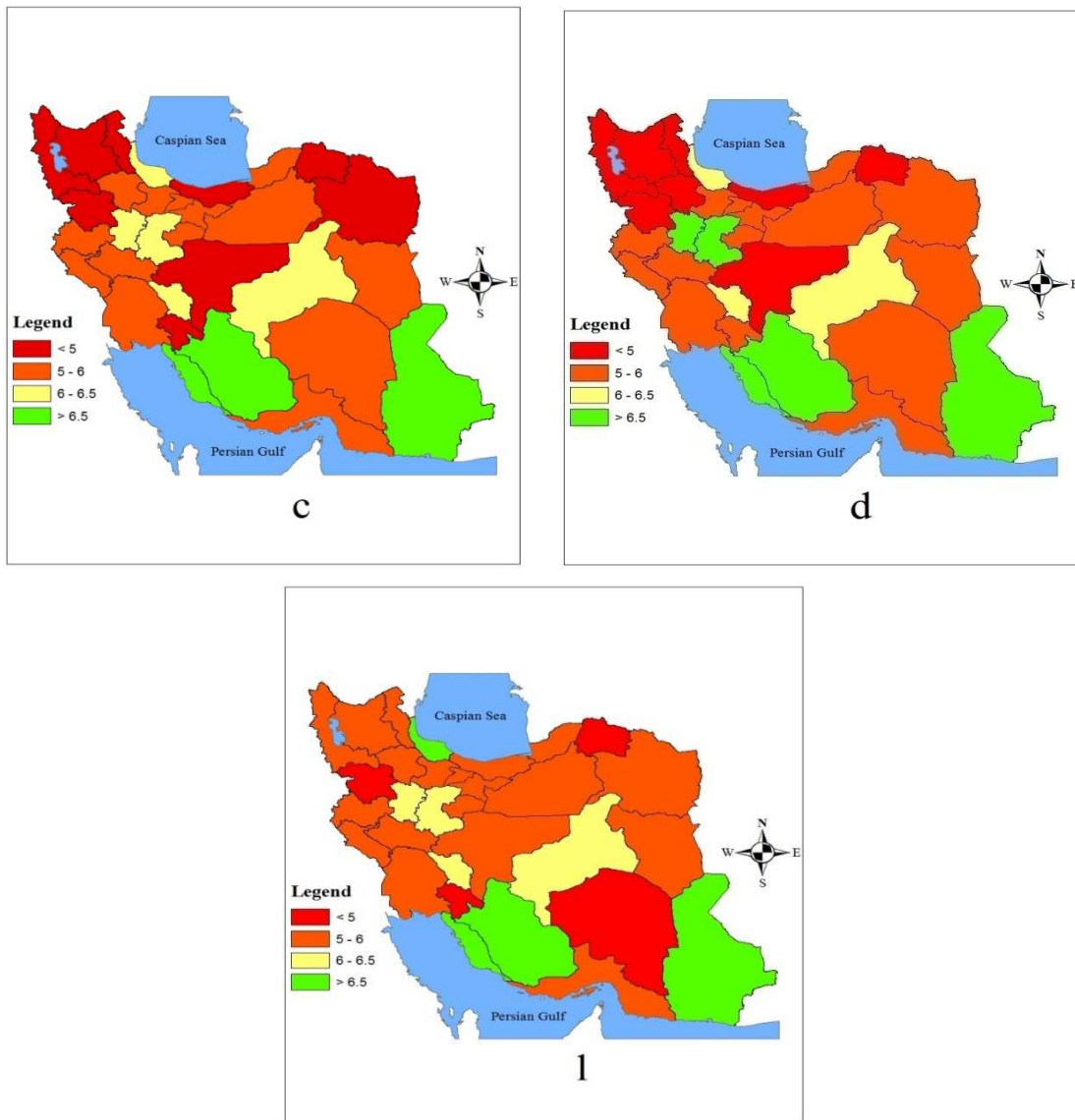


Fig. 3. Maps of potential UV exposure in people born in June (c), July (d) and March (l) in Iran based on 2012 UVI data.

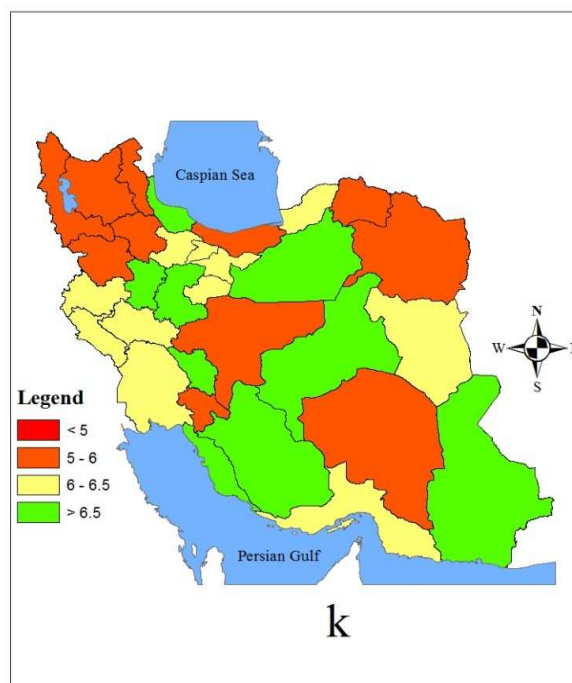
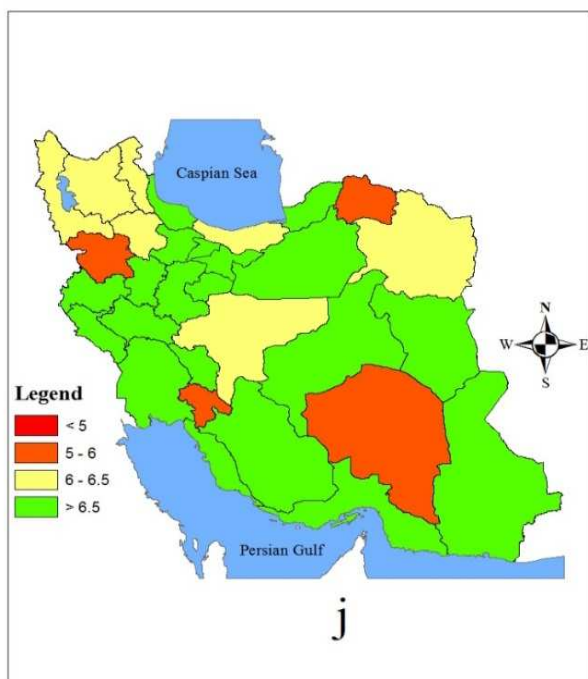
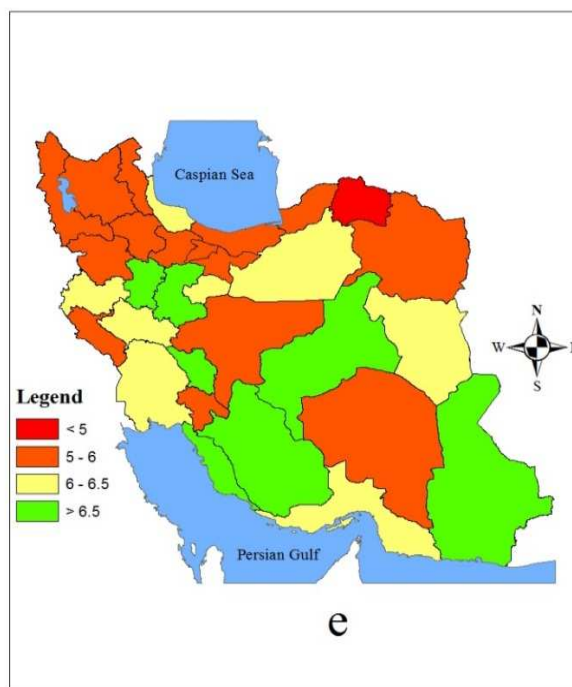


Fig. 4. Maps of potential UV exposure in people born in August (e), January (j) and February (k) in Iran based on 2012 UVI data.

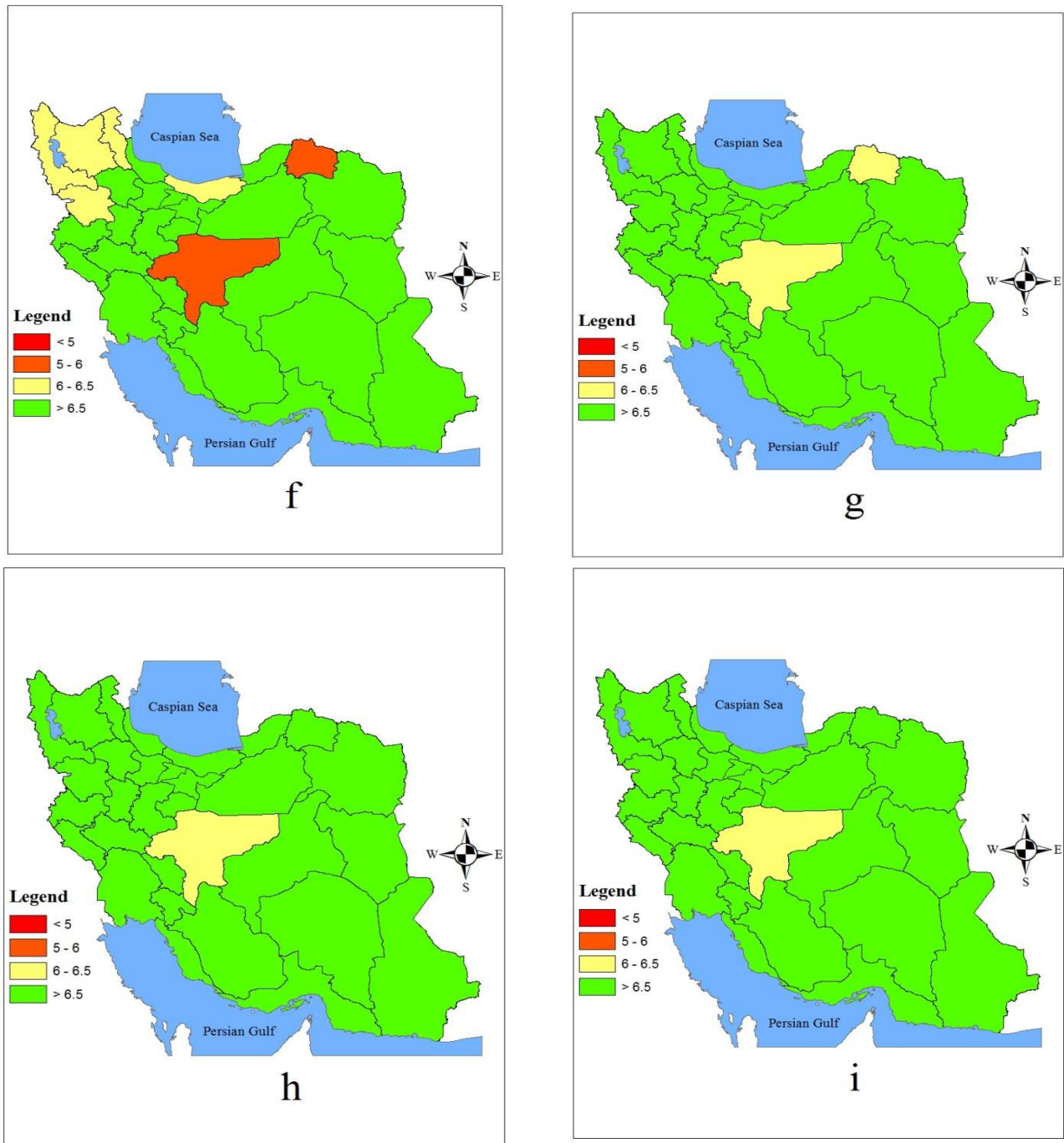


Fig. 5. Maps of potential UV exposure in people born in September (f), October (g), November (h) and December (i) in Iran based on 2012 UVI data.

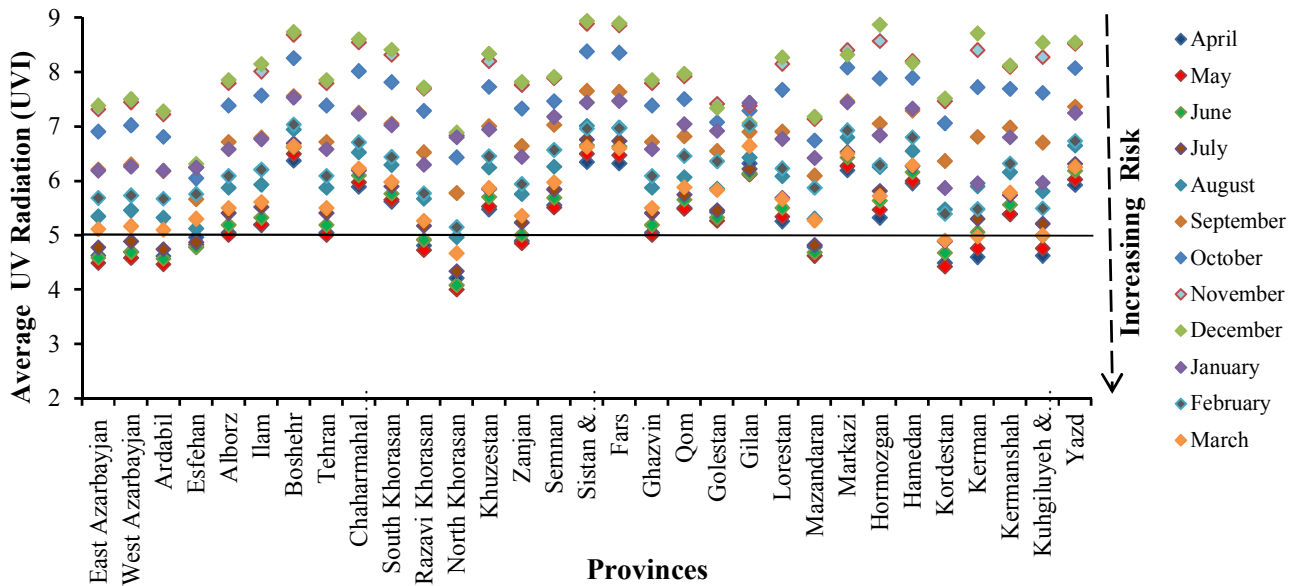


Fig. 6. The potential UV exposure in people born in 15th of each month.

## CONCLUSIONS

This study indicates that Iranian high exposure to UV radiation can reduce the risk of MS. The increased prevalence of MS among Iranian born in May has been shown which is due to maternal end-of-winter deficiencies in vitamin D, but a reduced risk of developing MS has been reported in Iranian born in November. A correlation between MS risk and sun had been suggested by Acheson. Dean had proved that there is a low risk of MS in UK migrants to sunny South Africa [6]. The inverse correlation between UV radiation and MS prevalence is shown in Australia and it has been proved that the regional variation in MS prevalence may be predicted by regional UV radiation levels [19]. In another study, it has been demonstrated that there is a negative association between mortality from MS and residential and occupational exposure to sunlight [20,21]. The prevalence of MS in southeastern Iran is in the intermediate range. But, recent studies showed increasing disease incidence [22]. In a study in Isfahan, high prevalence of MS has been proved and Isfahan is considered as a medium- to high-risk area for MS [23]. Iran is considered as a low-risk area for MS and the aim of this study was to evaluate the correlation between UV radiation and MS prevalence. Birth season can play a ma-

ajor role in MS development. The amount of winter sunlight affects the prevalence of disease and high ultraviolet exposure can cause low prevalence of MS. In this paper, we show that Iran is a low risk area for MS and people born in April and May are more susceptible to MS due to low exposure to UV radiation.

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## COMPETING INTERESTS

The authors confirm that this manuscript has not been published elsewhere and is not under consideration by another journal.

All authors have approved the manuscript and agree with its submission to JAPH and there exists no potential conflict of interest among authors.

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