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Sun Exposure on the Incidence of Allergies in Adult Women

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Abstract

Exposure to UVB rays in humans largely affects vitamin D synthesis, and approximately 90%–95% of vitamin D is produced in the skin. Allergic diseases have a significant impact on the health of the affected individuals. This study aimed to determine the relationship between sun exposure and the incidence of allergies in adult women. This research used a quantitative cross-sectional design. This research was conducted in Bogor from August to November 2023. The population investigated consisted of the entire adult female population living in the city of Bogor. This study used simple random sampling to select representative respondents. The data were collected using a questionnaire. The study sample comprised of 395 people. The inclusion criteria were women aged between 19 and 49 years who permanently resided in Bogor City. The exclusion criteria are women who are pregnant, breastfeeding, experiencing menopause, using hormonal contraception, and diagnosed with diabetes or other infectious or non-communicable diseases. Bivariate data was analyzed using the chi-square test to determine the relationship between sun exposure and the incidence of allergies in women in Bogor City. Processed shellfish foods and products are a common cause of allergies in women in Bogor. The frequency of sunbathing and the use of sunscreen have a significant effect on allergies. Sunbathing 2 times/week reduces allergies, whereas never sunbathing causes allergies. Sunscreen use increases allergies, and more research is needed to develop effective prevention strategies.

Introduction

Allergic diseases have a significant impact on the health and well-being of the affected individuals (Sánchez-Borges *et al*., 2018; Schmitz *et al*., 2017). Allergies are also associated with hereditary factors. In contrast, several non-genetic causes are believed to be responsible for the significant increase in the prevalence of allergic diseases that have occurred in recent decades (Ober and Yao 2011; Rueter *et al*., 2021). The increase in allergic diseases coincides with the trend in indoor lifestyle (Choi *et al*., 2022). Findings from the German Health Update show that around a third of people, from 18 to 79 years of age, report experiencing allergic conditions and are more common in women than in men, and occur more frequently in people with the highest levels of education (Schmitz *et al*., 2017).

Risk factors for allergic reactions include decreased exposure to microorganisms and infectious agents, decreased incidence of parasitic diseases, increased exposure to allergens, environmental pollution, changes in intestinal flora, and changes in diet, lifestyle, and travel patterns (Church 2004; Takano and Inoue 2017). Although other factors are involved, decreased exposure to sunlight is a risk factor for persistent allergic reactions (Rueter *et al*., 2021). The potential link between reduced sun exposure and an increased allergy risk is attributed to the immunological effects of reduced direct UV light exposure. Many studies

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in photobiology have shown that UV light can trigger immunomodulatory effects (González Maglio *et al*., 2016; Rueter *et al*., 2021).

Exposure to UVB rays in humans largely affects vitamin D synthesis, and approximately 90%–95% of vitamin D is produced in the skin through this process. Therefore, it is not surprising that vitamin D deficiency has emerged as a global concern, affecting more than a billion people worldwide (Matthias Wacker and Michaela F. Holick 2013; Chen *et al*., 2015; Rueter *et al*., 2021). However, studies on vitamin D supplementation have yielded unsatisfactory results in terms of allergy prevention, thus highlighting the potential effects independent of ultraviolet (UV) exposure (Rueter *et al*., 2021). Various studies have investigated the effects of vitamin D on the immune system, particularly its role in the development and regulation of innate and adaptive immunity (Maruotti and Cantatore 2010; Prietl *et al*., 2013; Bui *et al*., 2021).

Recent studies have shown that vitamin D has a significant impact on women's health. Sunlight is the main source of vitamin D. Indonesia is a tropical country that accounts for 90% of the world's vitamin D production. Due to its predominantly Muslim population, the city of Padang is characterized by a high prevalence of women wearing the hijab and engaging in indoor activities (Silvia 2022). Despite Indonesia's tropical climate, women of reproductive age who work indoors have low vitamin D levels, which can be attributed to the lack of exposure to ultraviolet B rays, the main source of vitamin D (Yosephin *et al*., 2014). Exposure to sunlight as an external source of vitamin D is influenced by the frequency and duration of exposure, use of sunscreen, skin type, and use of headscarves/covered clothing (Husna *et al*., 2021).

This study aimed to determine the relationship between sun exposure and the frequency of allergies in adult women in Bogor. The novelty of this study is that it focuses on the adult female population in Bogor, which may have different patterns of sun exposure to other populations. This is important because sun exposure can affect the immune system and cause allergic reactions in susceptible individuals. In addition, this research can also provide a better understanding of the environmental factors that contribute to the frequency of allergies in adult women in Bogor.

Method

The research design was cross-sectional. This means that the data were collected at one particular point in time and there were no follow-up observations. Cross-sectional research is useful for identifying relationships between variables in different populations. This method allows researchers to efficiently collect data from various groups or populations. Thus, cross-sectional research can provide a comprehensive picture of the relationships among these variables in a broad population. This study was approved by the Ethics Commission of the Faculty of Health Sciences, Ibn Khaldun University, Bogor (number 008/ K.11/ Kepk/FIKES-UIKA/2023. Approval from the Ethics Commission of the Faculty of Health Sciences, Ibn Khaldun University, Bogor, indicates that this research has undergone an evaluation process that ensures compliance with ethical principles. Thus, this study can be considered to have high integrity and credibility.

This research was conducted in Bogor from August to November 2023. The population investigated consisted of the entire adult female population living in the city of Bogor. This study used simple random samplings to select representative respondents from the population. The data was collected using a well-developed questionnaire. In addition, all data obtained will be processed and analyzed statistically to obtain valid and reliable results.

The minimum sample size was determined using Equation (Lemeshow, S. and David 1997). This calculation produced a value of n = 358.04, rounded to 359. Then add 10%. The total number of participants in the study was 395. The sampling procedure used was random sampling with the following inclusion criteria: women aged between 19 and 49 years who permanently resided in the city of Bogor. Women who are pregnant, breastfeeding, have experienced menopause, use hormonal contraception, have been diagnosed with diabetes or other infectious or non-infectious diseases, including active malignancies in the last 5 years, and are experiencing acute

inflammation were not included as subjects in this study. The subjects' consent was obtained through an informed consent form, which was signed voluntarily without any coercion. Data were collected by filling out a questionnaire containing information on the subjects' characteristics, sun exposure, and allergy history. Data were analyzed using univariate analysis for subject characteristics, source of vitamin D intake, sun exposure, and allergy history. Bivariate data were analyzed using the chi-square test to determine the relationship between sun exposure and the incidence of allergies in women in the city of Bogor.

Results And Discussion

Table 1. Subject Characteristics (n=395)

Characteristics	Σ	%
Age		
19-29 years old	333	84.3
30-39 years old	31	7.8
40-49 years old	31	7.8
Work		
Doesn't work	6	1.5
Student	233	59.0
Freelancers	9	2,3
Housewife	32	8.1
Laborer	2	0.5
Self-employed	13	3.3
Private sector employee	70	17.7
Teacher	22	5,6
Lecturer	8	2.0
Education		
No school	1	0.3
Finished elementary school	6	1.5
Finished middle school	8	2.0
Finished high school	283	71.6
Graduated from College	97	24.6
Frequency of sunbathing		
Never	8	20
1 time/week	114	28.9
2 times/week	79	20.0
3 times/week	75	19.0
4 times/week	30	7.6
5 times/week	29	7.3
6 times/week	10	2.5
7 times/week	50	12.7
Duration of sunbathing		

< 15 minutes	273	69.1
≥ 15 minutes	122	30.9
Use of sunscreen		
No	86	21.8
Yes	309	78.2
History of allergies		
Yes	163	41.3
No	232	58.7
Types of Allergies		
No history of allergies	232	58.7
Ingredients containing gluten (cereals, barley, etc.)	1	0.3
Shellfish and their processed products	51	12.9
Fish and its processed products	3	0.8
Eggs and their processed products	8	2.0
Milk and its processed products	1	0.3
Certain medications	9	2,3
Dust	22	5,6
Cold weather	68	17.2
Frequency of allergic events		
Never	232	58.7
≤ 4 times/year	93	23.5
> 4 times/year	70	17.7
Total	395	100.0

Table 1 shows that most of the subjects aged 19-29 years had student status. The highest frequency of sunbathing among students (28.9 %) used sunscreens for less than 15 minutes (69.1 %). Most people wore the hijab, and 41.3% had allergies, with shellfish and processed products being the most common.

Table 2 shows that, based on the statistical test results, the Likelihood Ratio obtained is p=0.000. It can be concluded that there is a significant relationship between the frequency of sunbathing and allergies in adult women in Bogor City ($p<0.05$). Adult women who sunbathe 2 times/week are more likely to not experience allergies, whereas adult women who never sunbathe experience allergies > 4 times/year.

Based on the statistical test results, the Likelihood Ratio obtained was p = 0.010 (Table 3). It can be concluded that there is a significant relationship between sunscreen use and the frequency of allergies in adult women in Bogor City ($p<0.05$). Subjects who used sunscreen experienced allergies more often (> 4 times/ year).

The findings show that awareness of sun protection was very high among students. They have extensive knowledge of the harmful effects of sun exposure and understand the importance of using sunscreens and wearing protective clothing. Additionally, many schools and educational institutions actively promote sun safety measures, which further contribute to high levels of awareness among students (de Troya Martín *et al*., 2019; Guy *et al*., 2016; Almuqati *et al*., 2019). This can be seen from the school policy, which requires students to wear hats or umbrellas outdoors and provide free sunscreens to students (Raymond-Lezman and Riskin 2023). In addition, several schools also hold educational programs on sun

Table 2. Relationship Between Frequency of Sunbathing and Frequency of Allergies in Adult Women in Bogor City

Frequency of sunbathing	Frequency of allergies								Likelihood Ratio (P Value)
	Never		**≤ 4 times/year**		**> 4 times/year**		**Total**		
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	
Never	0	0.0	1	12.5	7	87.5	8	100.0	
1 time/week	50	43.9	29	25.4	35	30.7	114	100.0	
2 times/week	59	74.7	16	20.3	4	5.1	79	100.0	
3 times/week	47	62.7	17	22.7	11	14.7	75	100.0	
4 times/week	18	60.0	10	33.3	2	6,7	30	100.0	0.000
5 times/week	16	55.2	9	31.0	4	13.8	29	100.0	
6 times/week	4	40.0	4	40.0	2	20.0	10	100.0	
7 times/week	38	76.0	7	14.0	5	10.0	50	100.0	
Total	232	58.7	93	23.5	70	17.7	395	100.0	

Table 3. Relationship between Sunscreen Usage and Frequency of Allergies in Adult Women in Bogor City

Sunscreen Usage	Frequency of allergies								Likelihood Ratio (P Value)
	Never		≤ 4 times/year		> 4 times/year		Total		
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	
No	39	45.3	24	27.9	23	26.7	86	100.0	0.010
Yes	193	62.5	69	22.3	47	15.2	309	100.0	
Total	232	58.7	93	23.5	70	17.7	395	100.0	

protection, such as seminars or workshops, to increase students' understanding of the importance of protecting themselves from the sun (Seidel *et al*., 2021). These initiatives not only educate students about the potential risks of sun exposure but also empower them to take proactive measures to protect their skin. By instilling these habits at a young age, schools play an important role in fostering a sun-safety culture that can have a long-term impact on students' overall health and well-being (Guy *et al*., 2016). In addition, the involvement of educational institutions in promoting sun protection underscores the recognition of sun safety as an integral part of holistic education (Diehl *et al*., 2023).

There is a significant relationship between the frequency of sunbathing and allergies in adult women in Bogor City. Adult women who sunbathe 2 times/week are more likely not to experience allergies, whereas adult women who never sunbathe experience allergies >4 times/year. This suggests that sunbathing may have a protective effect against allergies in adult women. These findings highlight the potential benefits of regular sun exposure in reducing allergic symptoms in certain populations. However, keep in mind that excessive sun exposure can increase the risk of skin cancer (Diao & Lee, 2013). Therefore, adult women need to maintain a balance between sunbathing and protection such as sunscreens (Al Robaee AA. 2010; Sultana 2020). Adult women are advised to consult a health professional to determine the amount of sun exposure appropriate for their individual needs. Additionally, other factors, such as genetics and lifestyle choices, can contribute to the development of allergies in adult women (Chen *et al*., 2020; Rennie *et al*., 2023), and more research is needed to fully understand the link between sunbathing and allergies. In addition, adult women need to pay attention to other factors that can influence the risk of allergies, such as diet and living environment (Murrison *et al*., 2019; Skypala and McKenzie 2019).

There is a significant relationship between the use of sunscreen and the frequency of allergies in adult women in Bogor. Subjects who used sunscreen experienced allergies more often (> 4 times/year). This study shows that the use of sunscreen can increase the risk of allergies in adult women in Bogor City. However, further research is needed to understand other factors that may influence the relationship between sunscreen use and allergy frequency. These factors may include specific ingredients in the sunscreen product used, the individual's skin type, and potential interactions with other environmental factors (Ngoc *et al*., 2019; Reis-Mansur *et al*., 2023; Latha *et al*., 2013). Psychological factors such as anxiety regarding sun exposure and sunscreen use can also influence the frequency of allergies in women (Nahar *et al*., 2013).

Shellfish food and processed products are the most common allergies experienced by women in Bogor City. There is a significant relationship between the frequency of sunbathing and allergies in adult women in Bogor City. Research shows that women in Bogor City, who are frequently exposed to sunlight, have a lower risk of developing allergies to shellfish and processed products. This demonstrates the importance of sun exposure in reducing the risk of allergies in adult women in cities. These findings suggest that sunlight may have a protective effect against shellfish allergies in women living in Bogor City, Brazil. Vitamin D produced by sun exposure may play a role in modulating the immune response and reducing allergic reactions (Sîrbe *et al*., 2022; Nahar *et al*., 2013). It is important to consider the genetic factors that may influence the immune response to shellfish allergies. Understanding the effect of genetic factors on the immune response to shellfish allergies is critical for developing personalized prevention and treatment strategies (Johanson *et al*., 2021).

Adult women who sunbathe 2 times/week are more likely not to experience allergies, whereas adult women who never sunbathe experience allergies >4 times/year. This indicates that regular sun exposure can help reduce the risk of allergies in adult women. However, it is important to maintain balance during sunbathing so as not to be exposed to excessive UV light. Excessive exposure to UV rays can increase the risk of skin damage and cancer. It is recommended to follow safe sun practices, such as wearing sunscreens, seeking shade during peak hours, and wearing protective clothing, to enjoy the benefits of sun exposure while minimizing potential risks. In addition, adult women need to pay attention to the right time to sunbathe. Exposure to sunlight in the morning or evening is recommended, because the intensity of UV rays is lower than that during the day (D'Orazio *et al*., 2013). Therefore, it can reduce the risk of skin damage and cancer caused by sun exposure. Additionally, it is important to check the skin regularly for changes or abnormalities, as the early detection of skin cancer can greatly increase the chances of successful treatment (Arivazhagan *et al*., 2022). Additionally, it is important to educate oneself and others about the dangers of indoor tanning beds, as indoor tanning beds also emit harmful UV rays that can cause skin damage and increase the risk of skin cancer.

Conclusion

Shellfish food and processed products are the most common allergies among women in Bogor City. There is a significant relationship between the frequency of sunbathing and allergies in adult women in Bogor City. Adult women who sunbathe 2 times/week are more likely to not experience allergies, whereas adult women who never sunbathe experience allergies > 4 times/year. There was a significant relationship between sunscreen use and the frequency of allergies in adult women in Bogor City. Subjects who used sunscreen experienced allergies more often (> 4 times/year). This shows that the frequency of sunbathing and the use of sunscreen can influence the level of allergies in adult women in Bogor. Further research is needed to understand the mechanisms underlying this relationship and develop effective prevention strategies.

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