

Original Research Article

Effects of clothes on hyperpigmentation and sunburn on people of India

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Received: 25 July 2024

Revised: 14 October 2024

Accepted: 29 October 2024

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ABSTRACT

Background: Many people suffer from sunburn and hyperpigmentation. Solar radiation can lead to hyperpigmentation as it easily triggers the production of melanin. Hyperpigmentation, sunburn and skin aging is determined by genetic aspects, lifestyle, and environmental factors. So, clothes likely to influence solar radiation related sufferings. The objective of the study is to test if suffering from solar radiation is associated with the nature of clothes used by the persons, what extent clothes can provide protection against solar radiation, and which type of clothes can provide maximum protection.

Methods: The Cohort study methods used for this study. The study done in two stages, first stage pilot study conducted to validate the instruments and methods used in the study. Second stage is the data collection and analysis for statistical testing and hypothesis testing.

Results: Persons wearing dark coloured loose and thick clothes covering most of their body parts can get 15 times more protection compared to the persons wearing light coloured tight and thin clothes covering less body parts.

Conclusions: People can protect themselves from solar radiation in an affordable manner by choosing appropriate clothing.

Keywords: Solar radiation, Nature of clothes, Hyperpigmentation, Sunburn, Effect

INTRODUCTION

Hyperpigmentation of the skin is a common dermatological condition in which the colour of the skin generally becomes darker. Skin hyperpigmentation is one of the most important dermatological concerns for persons with pigmented skin phototypes, with a high prevalence in the Indian population.¹ This happens mainly in women (90% cases) and only 10% of males of all ethnic and racial groups.² In India, 20-30% of 40-65 years old women present a facial melasma.³ Sunburn means radiation burn to the skin caused by too much exposure to the sun's ultraviolet (UV) rays or by artificial sources like tanning beds. An increase in the number of sunburns experienced by persons is directly correlated to an increased risk of skin cancer.⁴ Hence solar radiation

related disease is very important for India and easy and affordable preventive measures are likely to benefit all.

The research question is whether nature of clothes can prevent sufferings from sunburn and hyperpigmentation. The null hypotheses are formulated as follows: The sufferings from solar radiation are independent of amount of body parts covered by the clothes. The sufferings from solar radiation are independent of colour of clothes people wears. The sufferings from solar radiation are independent of the thickness clothes people wears. The sufferings from solar radiation are independent of the tightness clothes people wears.

The effect of solar radiation on skin pigmentation is a well-established fact. A direct correlation observed between the geographical distribution of UV radiation

and skin pigmentation worldwide.⁵ Sun sensitivity is also associated with higher sunburn prevalence and is independent of any race/ethnicity. So, efforts to improve vigilance and consistent use of sun protection are required.⁶

Sunburn increases skin cancer risk and is common among college-going women and men. Sunburn established to be commonly associated with tanning, increased time in the sun, and sports and vacationing.⁷ People having different types and natures of skin, do not react in the same way to Sun exposure. Persons with skin type I are the most sensitive and type VI is the most tolerant to UV radiation. The generation of skin sunburn, in its different degrees, have a significant effect of UV radiation.⁸ Sunburn was most often experienced during exercise and relaxation. Although some sun protection behaviours have changed, sunburn cannot be eliminated for all by using UV guard system especially during outdoor exercise.⁹ Individuals can reduce the risk of developing skin cancer by minimizing UV sunlight exposure. Both keratinocyte carcinomas (KCs) and melanomas may be ascribed to UV sunlight exposure.¹⁰ Sun-sensitive individuals more frequently engage in sun protective behaviours, especially by staying in the shade and using sunscreen. However, their sun-protective behaviours remained inadequate in preventing sunburns. Prevalence of vitamin D deficiency was not different between individuals with and without sun sensitivity and the odds of vitamin D deficiency was not associated with sun sensitivity, implying that better sun protection behaviours in this population did not compromise vitamin D status.¹¹

Hyperpigmentation that is changes in skin coloration may be the result of different internal and external factors including hormonal changes, inflammation, injury, acne, eczema, certain medication, UV exposure.¹² Alterations in melanocyte production or distribution of melanin result in skin hyperpigmentation disorders.¹³ Topical agents like cream, ointment or lotions are considered as 1st line treatment for hyperpigmentation, but they cause adverse effects such as skin irritation and peeling with higher concentrations. Chemical peels come next as 2nd line treatment, which have shown good efficacy but poses a greater risk of side effects and is more expensive. Oral therapies have usually demonstrated mixed results and more relapse rate. Laser and micro-needling therapies are approached as 3rd line treatment options due to limited data and usage history and high risk of side effects.¹⁴ Some plants and phytoconstituents, e.g., *Azadirachta indica*, *Glycyrrhiza glabra*, *Panax ginseng* and genistein, ellagic acid, quercetin, are very useful in herbal cosmetic as anti-hyper pigmentary agents in cosmetic industries. Some of flavonoids and triterpenoids present in plants also show their effect as antioxidants and skin whitening agents.¹⁵ Nanotechnology, using nanomaterials, has recently received increased attention in cosmetic industry. Lipid nanoparticles were found to be the most widely used nano-cosmeceutical in treating hyperpigmentation due to its high skin permeability,

biocompatible, and biodegradable its use as UV ray blocker. Several advanced formulations for skin whitening have been widely applied but treating hyperpigmentation has often been overlooked.¹⁶

Aim of the study was to find out the association of nature of clothes and suffering from hyperpigmentation and Sunburn among people of India. If association is established, then to find out the best clothes which provides protection from hyperpigmentation and Sunburn.

The extent in which protection against solar radiation can be achieved by choosing appropriate clothes.

METHODS

Study design

Study design was prospective cohort study.

Study place and period

Three states from different parts of India. Eastern India- West Bengal, Northern India-Uttarakhand, central India-Madhya Pradesh. Covered both rural and urban area. Study in different places conducted in different times. It started in July 2023 and data collection completed in June 2024. Study participants were subjected to study condition for 1 month duration.

Selection criteria

Persons stay in sunlight for 5-6 hrs a day were included and who not given consent were excluded.

Sampling sample size

Sample size is determined based on the confidence level, standard deviation among population and required precision as per formula ($n = Z^2 \times p \times (1-p)/d^2$), however at least 30 samples were taken for each category if the calculated sample size is less than that for that category.^{17,18} Confidence level for the study was taken as 95%, expected proportion on population based on pilot study is 0.15 and desired precision is 0.05. Hence sample size comes to 200. However, total of 20 categories are considered, hence sample size is taken as 600.

Sampling technique

Sample was taken randomly from the group of persons whose lifestyles are similar, to avoid bias. Time bias is eliminated as all participants are having similar time in indoor and outdoor activities.

Procedure

Hyperpigmentation determined with the help of dermoscopy.¹⁹ The sunburn determined with

questionnaire. Participants were asked whether they had experienced a red/painful sunburn/not.^{20,21} Questionnaire was tested for its validity and reliability with statistical software to ensure correctness of measurement.

Ethical considerations

The personal information of participants has not been revealed. The personal information has been codified and response was recorded against these codes. The code for each respondent was generated by taking the first letter of their first name; followed by first letter of their surname; age: 1 for less than 18 years, 2 for 18-40 years, 3 for 40-60 years and 4 for more than 60 years; gender: 1 for male and 2 for female; occupation: 1 for student, 2 for employed and 3 for unemployed; States: 1 for Madhya Pradesh, 2 for Uttarakhand and 3 for West Bengal; settlement: 1 for rural and 2 for urban; education: 1 for illiterate and 2 for below graduation and 3 for graduation and higher; income: 1 below poverty level, 2 above poverty level. The data entered in data entry sheet against these codes which is analyzed to ensure confidentiality.

Statistical analysis

Data is analysed with help of statistical software (SPSS).

RESULTS

Statistical tests were conducted to test the null hypothesis. The chi-square values were calculated from the data to test whether the differences observed between attributes are statistically significant. The value of chi-square = sum of (Expected frequency - observed

frequency)²/expected frequency. For each attribute there are 2 columns hyperpigmentation and sunburn observed and not observed. Two rows with having a particular attribute of clothes and not having that attribute. So the degree of freedom for each attributes are (2-1)×(2-1) or 1. The expected frequency for a row is calculated as the number of observed (having sunburn and pigmentation) in that row multiplied by the total observed (Column total of observed) divided by row total of that row. The calculated chi-square value was compared with the critical value of chi-square for 95% CI level and 1 degree of freedom value of which is 3.84. If the calculated value of chi-square is greater than 3.84, null hypothesis is rejected and the difference between the suffering observed for people who used clothes having an attribute and those not using clothes with that attribute, is significant. The data as percentage of persons suffered from sunburn and hyperpigmentation and not suffered is presented in Table 1. For all 4 attributes of clothes mentioned in the hypothesis calculated chi-square value is greater than the critical chi-square value at 95% CI level that is 3.84. So, all 4 null hypotheses got rejected and suffering from solar radiated diseases are found to be dependent on each of the above 4 mentioned attributes of clothes. The effect of nature of clothes and suffering from hyperpigmentation and sunburn is shown in Figure 1-4.

Statistical chi-square test for data presented in Table 1 rejects null hypothesis with 95% level of CI (p=0.05) and hence there exists an association between hyperpigmentation and sunburn with type of clothes person wears. A strong association was found between persons having sunburn and suffering from hyperpigmentation.

Table 1: Types of clothing wore and percentages of person suffered from hyperpigmentation and sunburn.

Persons with type of cloth	Observed	Not observed	Total
Persons covered most body parts*	10	90	100
Person covered less body parts*	40	60	100
Column total	50	150	200
Persons wearing dark coloured clothes**	12	88	100
Persons wearing light coloured clothes**	35	65	100
Column total	47	153	200
Persons wearing thick clothes***	17	83	100
Persons wearing thin clothes***	37	63	100
Column total	54	146	200
Persons wearing loose clothes****	16	84	100
Persons wearing tight clothes****	38	62	100
Column total	54	146	200
Persons covered most body parts with dark colour, thick and loose clothes*****	4	96	100
Persons covered less body parts with light colour, thin and tight clothes*****	60	40	100
Column total	64	136	200

*Calculated value of chi-square for above data=9.57 (>3.84), so persons covered most body parts by clothes have better protection from solar radiation. **Calculated value of chi-square for above data=5.63 (>3.84), so persons used dark coloured clothes have better protection from solar radiation. ***Calculated value of chi-square for above data=4.26 (>3.84), so persons used thick clothes have better protection from solar radiation. ****Calculated value of chi-square for the above data=5.15 (>3.84), so persons used loose clothes have better protection from solar radiation. *****Calculated value of Chi-square for the above data=33.36 (>3.84), so persons covered most body parts with dark colour, thick and loose clothes have much better protection from solar radiation.

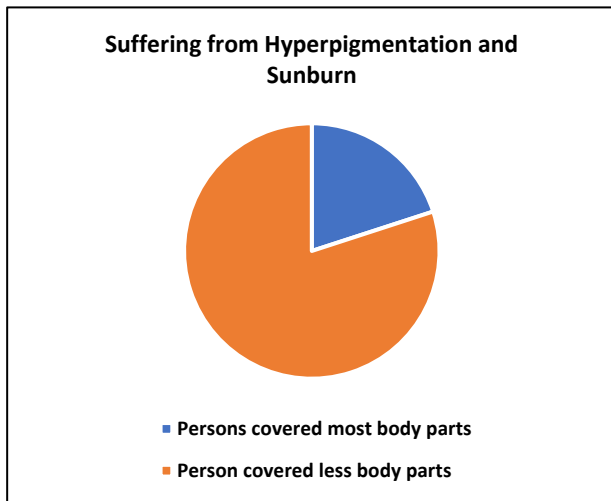


Figure 1: Effect of hyperpigmentation and sunburn due to partial covering of body parts.

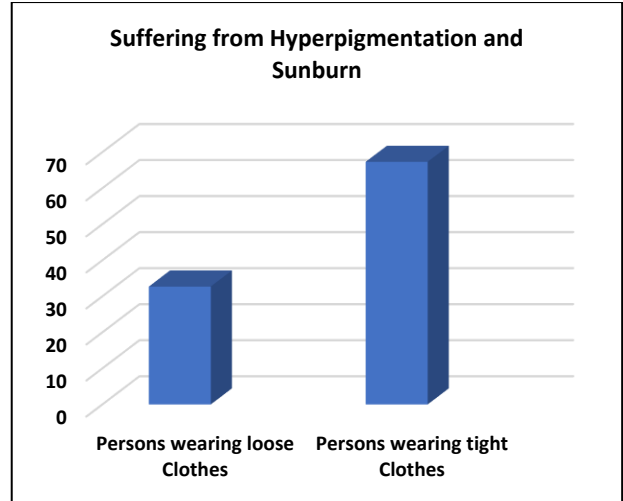


Figure 4: Effect of hyperpigmentation and sunburn due to tight clothes.

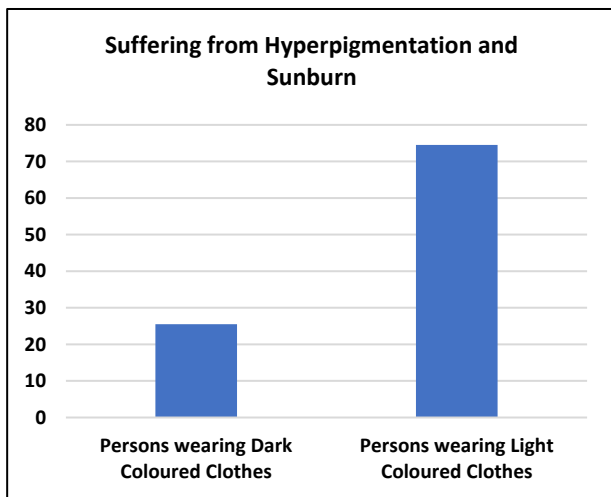


Figure 2: Effect of hyperpigmentation and sunburn due to wearing light coloured clothes.

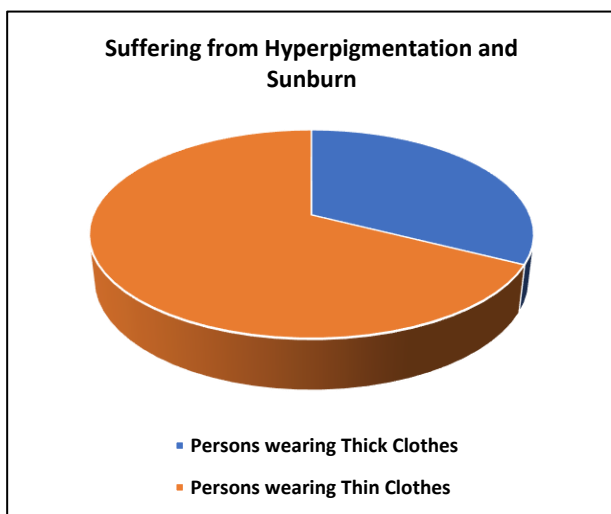


Figure 3: Effect of hyperpigmentation and sunburn due to thin clothes.

DISCUSSIONS

Sunburn increases skin cancer risk, and commonly associated with tanning.⁷ Sunburn cannot be eliminated for all by using UV guard system.⁹ Clothing has some sun-protection effects.²² So, sun-protection by selecting appropriate clothing can be beneficial. People covering more body parts with clothes like full sleeve shirts full pants etc are less likely to suffer from these problems. Significant protection from solar radiation was observed for persons wearing dark coloured like black, maroon and red clothes over the persons wearing light coloured like white, violet and blue clothes. Black colour clothes provide maximum protection while white colour provide minimum. Thicker and looser clothes also provide more protection from solar radiation. The combination of two factors increased the protection compared to a single factor and three factors gave more protection than two factors. All four attributes together can provide significant protection from solar radiation related problems. There exist different sun protection methods as mentioned in the introduction section. The nature of clothes used by study participants reveals, it can also contribute significantly towards skin protection.

The study conducted in different parts of India. The effect of sunburn of in other parts off worlds may slightly vary and the results may not be exactly reproducible.

CONCLUSION

An association exists between the nature of clothes worn by people and suffering from solar radiation like hyperpigmentation and sunburn. So, people choosing appropriate clothes can save themselves from solar radiation.

People can protect themselves from solar radiation by covering most of the body parts through clothes like hats,

full sleeved shirts, full pants etc, and choosing dark coloured loose and thick dress. The combination of two or more attributes mentioned above provides better protection. Persons wearing dark coloured loose and thick clothes covering most of their body parts can get 15 times more protection compared to the persons wearing light coloured tight and thin clothes covering less body parts.

So, by choosing appropriate clothes one can get skin protection from solar radiation in an affordable manner.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Kundu A, Kundu A. Effects of clothes on hyperpigmentation and sunburn on people of India. *Int J Res Dermatol* 2025;11:31-5.