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Intake of oral photoprotectors by postmen in Porto Alegre

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ABSTRACT

Introduction: Postmen are daily exposed to high levels of solar radiation, and lack of protection can result in many health damages. The present study aimed to identify cutaneous phototypes and evaluate the intake of oral photoprotectors by postmen.

Methods: Cross-sectional study, carried out from August 2011 to December 2012 in the city of Porto Alegre, state of Rio Grande do Sul, Brazil. Socioeconomic and behavioral data regarding daily solar exposure were collected through a questionnaire. To evaluate the intake of beta-carotene, lycopene and omega-3, two 24-hour dietary recalls were applied. Cutaneous phototypes were assessed by Fitzpatrick's classification.

Results: A total of 181 postmen were analyzed, whose mean age was 40.2±11.4 years old, and 140 (77.3%) were male. The cutaneous phototypes II, III and IV were the most prevalent (n=138), totaling 76.3% of the sample. The median for the oral photoprotectors intake was 1.16 mg (0.46-2.29) of beta-carotene, 3.60 mg (1.01-6.31) of lycopene and 0.95 g (0.61-1.45) of n-3 fatty acids, all values significantly lower than the minimal doses to obtain photoprotective effect (p<0.001). The individuals in the group of phototypes V and VI showed lower adherence to the use of sunscreen and lower intake of beta-carotene, comparing to the other groups.

Conclusions: The intake of oral photoprotectors is low in this population. Future studies may evaluate the real effect of oral photoprotectors, so that preventive measures using this approach can be included in photoprotection education actions for outdoor workers.

Keywords: *Diet; food and nutrition; skin aging; skin neoplasms; occupational health*

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The exposure of the skin to ultraviolet (UV) solar radiation has as its main benefit the endogenous synthesis of vitamin D3, which is fundamental for various metabolic processes of the organism[1]. However, when excessive, it presents health risks, such as inflammation, immunosuppression, DNA damage and gene mutations, which can progress to ocular damage and skin cancers[1].

Acute and chronic effects can be attributed to UV radiation on the skin. The acute effects include elevation of skin temperature, burn and pigmentation. The chronic effects are photoaging and skin cancer, being the latter the main concern in terms of public health. In addition to these effects, exposure to UV radiation can promote photodermatoses or accentuate other diseases, called photoaggravated dermatoses[2].

The main factors that determine the dose of UV radiation to which a person is subjected over a lifetime are behavioral, such as time and range of exposure to sunlight, as well as the adoption of protective measures. Occupations involving daily sun exposure (postmen, lifeguards, construction workers, agricultural workers and others) receive two to nine times higher charges of ultraviolet radiation during the year compared to workers in other activities[3,4].

The association between occupational exposure to ultraviolet radiation and incidence of skin cancer is already well established in the literature.

Studies show that the risk of developing cancer is approximately twice as high when there is an excessive daily solar exposure of workers, comprising, thus, a new category of occupational disease[4,5].

The cutaneous phototype has an important influence on the aggravations to the appearance and on the manifestation of diseases related to the skin. The Fitzpatrick scale gradually classifies the skin phototypes from I to VI, being phototype I the individual whose skin always burns and never tans, and phototype VI the individual whose skin never burns and always tans, setting degrees of higher to lower sensitivity to the effects of UV radiation[6].

The cutaneous phototypes I to III are the most sensitive to the effect of UV radiation, because they have a lower production of melanin, the main physiological skin photoprotective mechanism and determinant of the pigmentation of the skin, eyes and hair. For this reason, they are more susceptible to injuries due to excessive sun exposure[6,7].

The set of measures aimed at reducing sun exposure and/or preventing its deleterious skin effects is called photoprotection. According to the Brazilian Society of Dermatology, the main photoprotective measures are: photoprotection education, mechanical protection (covers, glasses, clothes and accessories), topical photoprotectors, and oral photoprotectors[2].

Oral photoprotectors are sources of endogenous protection obtained through feeding or supplementation. These compounds act in the development of the protective barrier of the skin against solar radiation, in the antioxidant action protecting biomolecules, in the induction of cellular repair systems, and in the anti-inflammatory action[8-10]. The nutritional contribution has a complementary role to the other photoprotective measures[8,11]. Several foods, nutrients, and bioactive compounds of foods have been pointed out in recent studies as having photoprotective effects on the skin through its regular consumption. Among them are carotenoids, flavonoids, polyphenols, caffeine, omega-3 polyunsaturated fatty acids, vitamin C, vitamin E, and selenium, plus some possible combinations between them[9,12-15].

Postmen are daily exposed to high levels of solar radiation, whose lack of protection can result in various health hazards. Considering the importance of nutrients with a potential photoprotective effect to prevent numerous diseases, studies are necessary to evaluate the dietary intake of these compounds, especially in workers who are frequently exposed to a high load of solar radiation.

The objective of the present study was to identify cutaneous phototypes and to evaluate the consumption of oral photoprotectors in postmen from Porto Alegre.

METHODS

A cross-sectional study was conducted between August 2011 and December 2012 in the city of Porto Alegre, state of Rio Grande do Sul. Postmen from the Brazilian Post and Telegraph Company - Regional of Rio Grande do Sul, from six Different Home Delivery Centers were invited to participate. These centers were selected through geographical mapping and agreement of local management. Inclusion criteria were daily occupational sun exposure, age older than 18 years and a minimum of one year of professional activity. The research project was approved by the Research Ethics Committee of the Faculty of Medicine/UFRGS (nº124), and by the Research Ethics Committee of the IPA University Center (nº2010). All participants signed the informed consent form.

Data collection was performed by previously trained nutrition students, and took place in the units of the Domiciliary Distribution Centers, in a place reserved for this purpose. By means of consecutive sampling[16], the recruited postmen were invited to respond to an objective questionnaire of general identification and socioeconomic variables, as well as specific questions regarding their behavior towards daily sun exposure[17], which were adapted from the application in a sub-sample (6% of the sample).

To evaluate the intake of potential photoprotective factors (beta-carotene, lycopene and omega-3), two 24-hour dietary reminders (R24h) were applied. Daily dietary intake was assessed with a nutrition aid program (DietWin® Software), which uses the Brazilian Food Composition Table[18], and the Brazilian Sources of Carotenoids Table[19]. Minimum doses were considered for photoprotective effect: 24 mg of beta-carotene[20], 10 mg of lycopene[21] and 3 g of omega-3[15], according to the most recent scientific production available.

Cutaneous phototypes were identified by self-report according to the Fitzpatrick Scale[6], the most common method and widely used in studies for this purpose[7].

The sample size calculation was performed with the WINPEPI program[22], considering prevalence studies with the outcome, sampling error of 5%, 95% confidence interval, 10% for possible losses, and 12% for associations.

For statistical analysis, the study participants were grouped into three categories, according to cutaneous phototypes (I and II, III and IV, V and VI), considering the sample size and the particularities of the categories. The qualitative data are expressed in absolute (n) and relative (%) frequencies. The parametric quantitative data are expressed in mean and standard deviation and the nonparametric quantitative in median and interquartile range. The comparison of the phototype

categories regarding the general characteristics of the participants and the characteristics related to the behavior towards sun exposure was performed using the chi-square test. The normality of quantitative variables was assessed using the Shapiro-Wilk test. The comparison between the intake of oral photoprotectors with the minimum doses for photoprotective effect was performed using the Wilcoxon test, considering that the variables presented a non-parametric distribution. The comparison between cutaneous phototype categories for calorie intake, macronutrients, and oral photoprotectors was performed by the Anova or Kruska-wallis test, respecting the normality of the variables. Statistical analyzes were performed in the SPSS package version 18.0, and significance was established at $p < 0.05$.

RESULTS

A total of 204 postmen were interviewed, of which 23 were excluded because they did not perform primarily outdoor activities under sun exposure, totaling 181 pedestrians. Of these, 140 (77.3%) were men, with a mean age of 40.2±11.4 years, and 114 (62.9%) were married. As for education, the mean was 13±2.5 years of study. A small number of the sample reported smoking, including 14 (7.7%) individuals. The predominant cutaneous phototypes in the sample were II (26%), III (25.4%) and IV (24.9%), totaling around 76% of the individuals interviewed. The general characteristics of the sample are shown in Table 1.

Table 2 shows the behavior of the individuals towards sun exposure. The mean daily hours of occupational sun exposure was 3.6±0.8 hours. The main time

Table 1: General characteristics of the sample of postmen (n=181).

Characteristics	Phototype I N= 8	Phototype II N= 47	Phototype III N= 46	Phototype IV N= 45	Phototype V N= 12	Phototype VI N= 23
Male gender	5 (62.5%)	37 (78.7%)	37 (80.4%)	32 (71.1%)	11 (91.7%)	18 (78.3%)
Age (years)	41.87±10.09	35.47±10.25	40.11±11.29	42.66±12.81	43.17±11.58	43.26±9.04
Marital status						
Single	2 (25%)	15 (31.9%)	10 (21.7%)	11 (24.4%)	6 (50%)	8 (34.8%)
Married	4 (50%)	27 (57.5%)	35 (76.1%)	30 (66.7%)	4 (33.3%)	14 (60.9%)
Divorced	2 (25%)	5 (10.6%)	1 (2.2%)	4 (8.9%)	2 (16.7%)	1 (4.3%)
Education (years of study)	12.25±1.75	13.25±2.38	13.52±2.67	12.59±2.36	12.5±2.07	12.26±2.05
Smoking (yes)	2 (25%)	1 (2.1%)	3 (6.5%)	5 (11.1%)	1 (8.3%)	2 (8.7%)

Data presented in absolute (n) and relative frequency (%) or mean and standard deviation.

Table 2: Behavior of postmen towards sun exposure (n=181).

Characteristic	Phototypes I and II (n=55)	Phototypes III e IV (n=91)	Phototypes V e VI (n=35)	*p* value*
Solar exposure ≤ 18 years				
None	1 (1.8%)	4 (4.4%)	2 (5.7%)	0.731
Light/Mild	44 (80%)	65 (71.5%)	23 (65.8%)	
Severe	10 (18.2%)	22 (24.2%)	10 (28.6%)	
Solar exposure > 18 years				
None	0	0	0	
Light/Mild	31 (56.4%)	44 (48.4%)	16 (45.7%)	0.164
Severe	24 (43.6%)	47 (51.6%)	19 (54.3%)	
Use of hat/cap				
Daily	33 (60%)	48 (52.7%)	19 (54.3%)	0.790
Occasionally	9 (16.4%)	19 (20.9%)	9 (25.7%)	
Daily use of sunscreen on the face	34 (61.8%)	40 (44%)	10 (28.6%)	**0.007**
Daily use of sunscreen on uncovered areas	39 (70.9%)	47 (51.6%)	13 (37.1%)	**0.005**
Reapplication of sunscreen (4h)	4 (7.3%)	2 (2.2%)	1 (2.9%)	0.287
Use of long clothes				
Daily	4 (7.3%)	3 (3.3%)	1 (2.9%)	0.733
Only in winter	49 (89.1%)	78 (85.7%)	32 (91.4%)	0.642

Data presented as absolute and relative frequency; *Chi-square test.

of exposure was between 1p.m. and 2 p.m., when 139 (76.8%) of the interviewed postmen performed outdoor activities. The use of sunscreen applied daily on the face was reported by 84 (46.4%) workers, wearing a hat or cap was reported by 100 (55.2%), and wearing long clothing throughout the year, by only 8 (4.4%) individuals. The individuals in the group of phototypes V and VI showed significantly less adhesion to the sunscreen, compared to the other groups ($p < 0.05$). After adulthood, 90 (49.7%) individuals reported frequent sun exposure, while 42 (23.2%) subjects reported exposure prior to age 18.

Regarding food consumption, participants reported a mean caloric intake of 2,387.3±668.9 kcal/day, with a prudent distribution of macronutrients. The median intake of oral photoprotectors was 1.16 mg (0.46-2.29) of beta carotene, 3.6 mg (1.01-6.31) of lycopene and 0.95 g (0.61-1.45) of n-3 in the general sample, all values significantly lower than the minimum doses to obtain photoprotective effect ($p < 0.001$), which would be 24 mg, 10 mg and 3 g, respectively. None of the postmen evaluated in this study reached the intake of the minimum dose of beta-carotene indicated. Only 15 (8.3%) postmen presented an intake of lycopene equal or greater than the indication, and 9 (4.97%), presented an intake of omega-3 higher than or equal to the indication.

The data on calorie intake, macronutrients and oral photoprotectors are shown in Table 3. A statistically significant difference was observed only in the intake of beta-carotene, being lower among postmen with phototypes V and VI when compared to the others ($p = 0.031$).

DISCUSSION

The present study observed that the consumption of beta-carotene, lycopene and omega-3 was lower than the minimum doses indicated to obtain a photoprotective effect. Individuals in the group of phototypes V and VI showed lower adhesion to the use of sunscreen and lower consumption of beta-carotene, in comparison to the other groups.

Despite the admittedly diminished risk for developing skin cancer in ethnically-skinned individuals, the disease may develop and be late diagnosed because of reduced concern with this condition. In addition, these individuals are at increased risk for hyperpigmentation disorders. Therefore, the adoption of photoprotective measures is recommended for all cutaneous phototypes without distinction[2].

The results showed high UV radiation to which these workers are exposed daily (3.6 hours/day). Lewis et al.[23], investigated 2,600 postmen and found a mean sun exposure of 3.9 hours in working days. Despite the high exposure, the present study observed low adhesion to photoprotective measures, such as sunscreen, clothes and accessories. On the other hand, Popim et al.[24] observed the use of sunscreen in approximately 63% of the postmen interviewed, caps in 69%, long trousers in 72%, and long-sleeved shirts in 34%.

Severe sun exposure among postmen evaluated rose from 23.2% before age 18 to 49.7% in adulthood. Similar results are found by Godar et al.[25], who observed an exposure lower than 25% of the total load of UV radiation before age 18.

Regarding the use of sunscreen, in this study it was observed a greater adhesion by phototypes I and II and III and IV when compared to individuals of phototypes V and VI. The way sunscreen is offered (through gallons of collective use) may be one of the possible causes that explain the high rate of non-reapplication of sunscreen.

The intake of oral photoprotectors was low in the studied population. In other studies, the photoprotective effect is demonstrated, possibly, by the use of supplementation of these nutrients. Heinrich et al.[26] demonstrated that daily supplementation of beta-carotene with doses starting at 24 mg (or similar dose of a carotenoid combination) for 12 weeks protects the

Table 3: Energy intake of macronutrients and oral photoprotectors in postmen (n=181).

	Phototype I and II (n= 55)	Phototype III and IV (n =91)	Phototype V and VI (n = 35)	*p* value
Calories (kcal/day)	2,344.1±705.8	2,410.6±685.0	2,401.0±597.2	0.848[1]
Protein (% do VET)	18.60±4.70	18.41±4.26	18.34±4.21	0.954[1]
Carbohydrates (% do TEV)	53.25±6.53	51.01±7.25	52.84±6.80	0.208[1]
Lipids (% do TEV)	28.15±5.52	28.28±5.16	30.65±5.08	0.053[1]
Beta-carotene (mg/day)	1.36 (0.75-2.35)	1.04 (0.50-2.24)	0.52 (0.27-2.30)	**0.031**[2]
Lycopene (mg/day)	3.62 (1.38-7.00)	3.60 (0.86-6.7)	3.00 (0.52-4.60)	0.297[2]
Omega-3 (g/day)	0.93 (0.51-1.41)	0.86 (0.56-1.48)	1.09 (0.73-1.53)	0.250[2]

TEV = total energetic value; Data presented as mean and standard deviation or median and interquartile range[1]; Anova Test[2]; Kruskal-Wallis Test.

skin against sunburn. A meta-analysis conducted by Köpcke and Krutmann[20] demonstrated the efficacy of beta-carotene supplementation in photoprotection in humans, acting against the onset of sunburn. The protection depends on the duration of the intervention. The minimum beta-carotene supplementation time to achieve a significant photoprotective effect is ten weeks[20]. In relation to lycopene, Stahl et al.[27] demonstrated that daily consumption of 40 g of tomato extract (16 mg of lycopene) for ten weeks decreased the formation of erythema after exposure to solar radiation by 40%, while Aust et al.[21] found an increase in the skin's ability to protect against UV radiation through the daily intake of approximately 10 mg of lycopene for twelve weeks. Furthermore, Rizwan et al.[28] have demonstrated that the daily intake of 16 mg of lycopene for 12 weeks provides protection against acute skin damage caused by sun exposure and potentially also in the long term, due to the reduction of damage at the molecular/cellular level. Daily supplementation of 4 g of omega-3 (2.8 g of EPA and 1.2 g of DHA) for four weeks offered a small but significant effect on the increase in the minimum UVB dose required to cause erythema[29]. The daily supplementation of 5 g of omega-3 (70% EPA and 10% DHA) for three months showed an effect against photo-immunosuppression, but the difference was not significant[30].

The main limitations for this type of assessment are the lack of specific validated instruments and the fact that the safe recommendations for provision of systemic photoprotection have not yet been clearly established. In addition, it is a cross-sectional study, which does not include an investigation of causality and effect.

The present study observed that the intake of beta-carotene, lycopene and omega-3 was significantly lower than the minimum doses previously indicated for photoprotective effect. Future studies, with a randomized clinical trial methodology, should be performed to evaluate the real effect of oral photoprotectors, so that preventive measures using this approach can be included in photoprotection education actions for outdoor workers.

Conflicts of interest

The authors declare no conflicts of interest.

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